POWER

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Social and Industrial Anomalies

THERE are things that seem to be reflections upon our vaunted civilization and upon the ability of its rulers to utilize its resources and facilities for the general well being.

Is it not a curious paradox that the invention and employment of labor-saving machinery, the economies of consolidation and reorganization, should result in deprivation and misery to so many people?

In order that man may live upon a given plane a certain amount of work must be done in the world. To an onlooker it would seem that anything that would make that work easier, that would take less time and man-power to do it, would mean a better living for everybody.

The answer will be that it does eventually, but some of the millions who are out of a job today think it is a long time getting around.

Is it not an anomaly that mills and factories should be shut down by lack of demand for their products while thousands are needing, some of them suffering from the want of them? And the reason that they cannot buy them is that they cannot get into the mills and by making them earn the money to pay for them.

With the application to the eternal struggle of accumulated knowledge and experience and scientific discovery; with the employment of the marvelous tools and machinery at our command; with facilities for handling, storing and distributing that have never been equaled; with uses for portions of the product formerly thrown away; with all the economies that should result from doing things upon a big scale—a consumer ought to be able to exchange his day's work for more of the commodities of life than ever before.

With all of our facilities for the rapid concentration of information and for the distribution and interchange of materials and products, is it too much to expect that some time our essential industries will be run as a unified, regimented, interrelated whole instead of a diffusion of competing and collectively undirected units?

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What of the New Year?

WITH the beginning of a new year it is always well that the past twelve months shall be reviewed and that an effort shall be made to peer into the possibilities of the future. Because of the generally unsettled condition of business during the latter part of 1930, the question of what the new year holds for the power field is of unusual interest.

On this account *Power* has undertaken a careful and extensive canvass of representative companies and executives engaged in the manufacture of power generating machinery or the generation and use of power. A digest of opinions has been made which has resulted in a composite view, representative of no particular viewpoint, but the resultant of the whole.

ACCORDING to the report of the National Electric Light Association, the actual expenditure last year for all electrical development was about 850 million dollars, while for the year 1931 the contemplated expenditure is 700 million dollars. No figures are available from the N.E.L.A. which would show the proportion of the 1931 estimate devoted purely to power generating plants. Independent figures, reliably arrived at, covering last year's expenditures for purely power generating plants show steam installations at 208 million dollars and water-power installations at 117 million dollars.

For 1931 the same sources show 202 million dollars to be spent in steam generating plants and 105 million dollars on hydro. Despite the sub-normal conditions of 1930 and the effect of numerous rate reductions, the electric utilities recorded gross revenues for the first ten months 3.9 per cent higher than for the same period of 1929.

Central station construction during 1930 consisted largely of the completion of power plants which were started in 1929 or earlier. Work on a few new plants was started during the year and preliminary or final plans for a number of other new stations are nearing completion. It is evident from reports that current extensions to existing plants will proceed as usual to conform with the growth of the system load.

A HEALTHY and active interest in industrial power plants is apparent. Industrial executives point out, through their composite voice, the necessity for securing cheaper power. This need has led a number to the making of plans for modifications and modernizing, the consummation of which await only the signs of business recovery. A number of new high-pressure industrial power plants, together with a considerable rejuvenation of others in the process industries, were completed during 1930.

More than half of the industrials interviewed report that they plan no changes in the budgets for 1931 as compared with those of 1930. A goodly number report increased budgets for power work, while a smaller group will operate upon somewhat curtailed budgets. Quite a number of companies state that they are are holding up projected work pending clarification of the present business situation. Some expect this to become apparent in the early months of the new year, but there is no uniformity of opinion as to the probable time for business recovery, since

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each situation is greatly influenced by local conditions and the early recovery of allied industries.

Among the public institutions, the outlook for greater activity is good. Unemployment relief plans, involving, as they do, an unusual activity in public construction, are partly responsible for this. A comprehensive program which undertakes the rehabilitation of the power plants to better the operating economy in its public institutions is already under way in one state.

SOME consulting engineers have been busy throughout the past year and have plenty of work ahead, while others have not been so fortunate. The activity is mostly in industrial engineering groups, although the public utility group is not neglected.

There is abundant evidence, through consulting engineers' reports, of intention to improve the economy of power production. Numerous studies are under way in this direction, and there is evidence that reconstruction, possibly more than plant extension, will characterize the work in the industrial field in the immediate future. In addition, there is evidence in the reports that the new year will also see the completion of considerable deferred maintenance and the replacement of obsolete equipment.

AMONG the equipment manufacturers it is significant that many are engaged in the preparation of proposals upon new work and that the nature of their inquiries gives confidence and a feeling of brighter outlook for 1931. As a class the manufacturers have been less affected by the depression than others. A considerable number report better sales volume in 1930 than the year previous. Others indicate a satisfactory average for the year, with orders falling off during the last quarter. A very small number of manufacturers are distinctly pessimistic in their outlook. There is a distinct evidence of the fighting spirit, and faith in the future is shown in the number who have taken advantage of the slack period to modernize their plant facilities and to set up their products and their sales programs for the morrow.

The oil engine manufacturers enjoyed a period of unusual activity during the past few months and closed their year with business not more than ten per cent under 1929. Manufacturers generally are optimistic for the year 1931, as they feel that, with improved designs and the expected growth of market demand, there is no reason for other than a comfortable outlook.

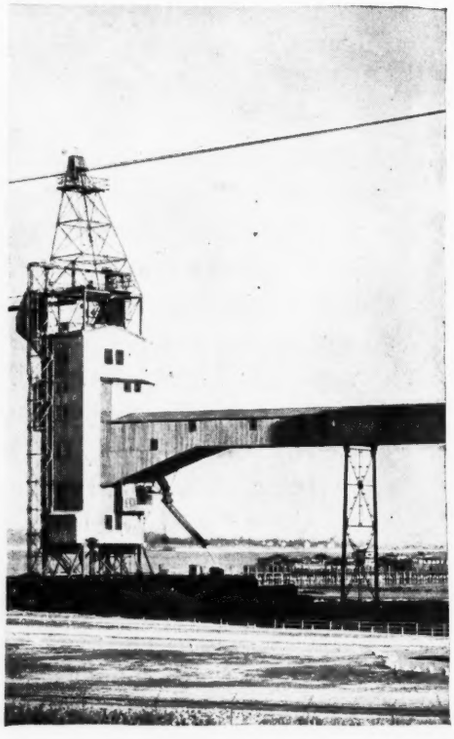
DESPITE the fact that comparatively little noise has been made by the water power people, a grouping of figures shows plainly that during the year 1930 over 1,000,000 horsepower in hydro-electric plants went into commission in this country. In addition, orders still under contract in the United States alone total over 2,000,000 horsepower. Of this amount, it should be pointed out 800,000 horsepower will be installed in Russia and other foreign countries. It will be seen from these figures that there is no indication of decadence in hydro power.

Quite apart from the strict report, it is difficult to leave the broad subject of what the new year holds for the power field in 1931 without pointing out that the very conditions which have been brought about by the reduction of business activity during the past twelve months, namely, low commodity prices and plenty of labor, are the best arguments for starting new construction now. It is doubtful if for many years to come such favorable building conditions will be available for those who have work to do.

1930's Contribution to St

Several 1,200-1,400 lb. plants put in service. New records in station performance attained. Pressures of 400 and 600 lb. become more general in industrial plants. Urge toward reduced initial investment being reflected in new station designs

Lincoln, Beerbower plant, Oklahoma Gas & Electric Company, has 15,000 kw. installed and operates on 400 lb., 750 deg. F. steam



Jersey Central Power & Light Company's plant, South Amboy, N. J., has two 25,000-kw. units and 1,400-lb. boilers

SINCE appreciable gain in the thermal efficiency with present steam cycles is to be obtained only with growing complication and expense, so the law of diminishing returns is forcing progress in the direction of lower investment cost without sacrifice in present economies. Simplicity of station layout, careful allocation of surface between boiler, economizer and air heater, operation at high rating, better reliability of equipment to decrease outages and eliminate duplication and reserve capacity—those are some of the factors contributing to this end. To reduce building costs, some outdoor installations are being considered. More practical means already in process are the trend toward more simple turbine design evidenced by the increased capacity of single-shaft units, the introduction of vertical-compound turbines to save floor space without adding to building height, and ever growing size of boiler units.

An outstanding example of these trends is the recent addition to the East River generating station of the New York Edison Company. The first two units in the plant were 60,000-kw. machines. When it was decided to make the first extension, single-turbine generators of 160,000 kw. capacity were available at considerably lower cost per kilowatt. It was then decided that in the extension of the station the same number of units as originally planned would be installed, but that they would have nearly three times the capacity of the original machines. Three double-ended pulverized-coal-fired boilers nominally rated at 1,000,000 lb. of steam per hour, but with considerable overload capacity, were installed. Recent tests on one of these boilers showed a steaming capacity as high as 1,250,000 lb. per hour. Incidentally, at the present time there are in operation in the world only five turbines requiring more steam than one of these large boilers will supply. The one-boiler, one-turbine dream has become a reality.

The saving in floor space and cubical contents effected by these large units at East River is reported as follows: Turbine-generators 1 and 2 (60,000 kw. capacity each) occupy 0.083 sq.ft. per kilowatt capacity, while turbine-

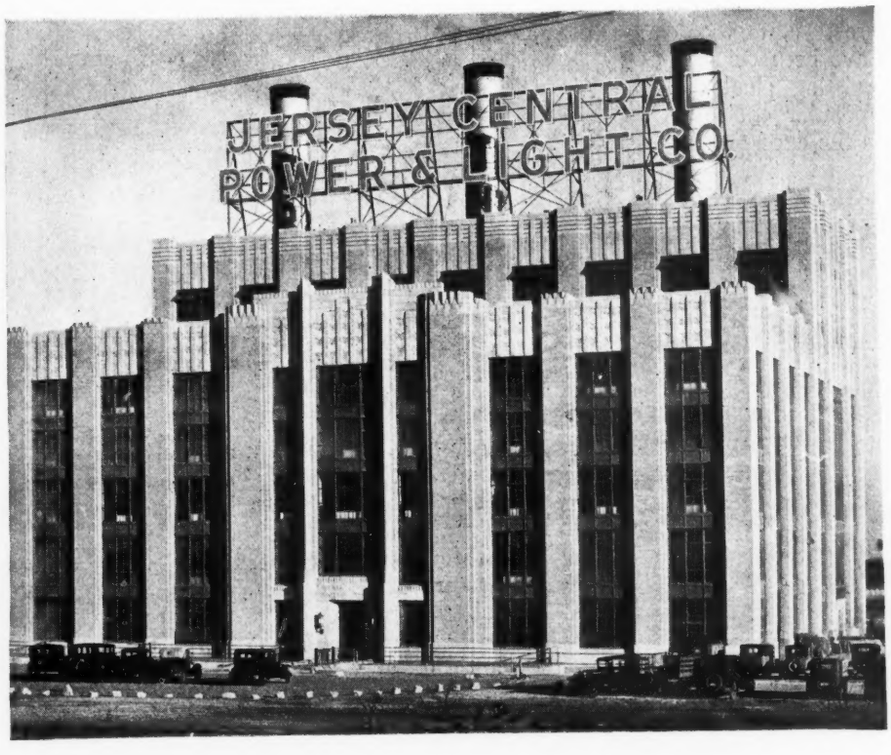
Steam Plant Design and Construction

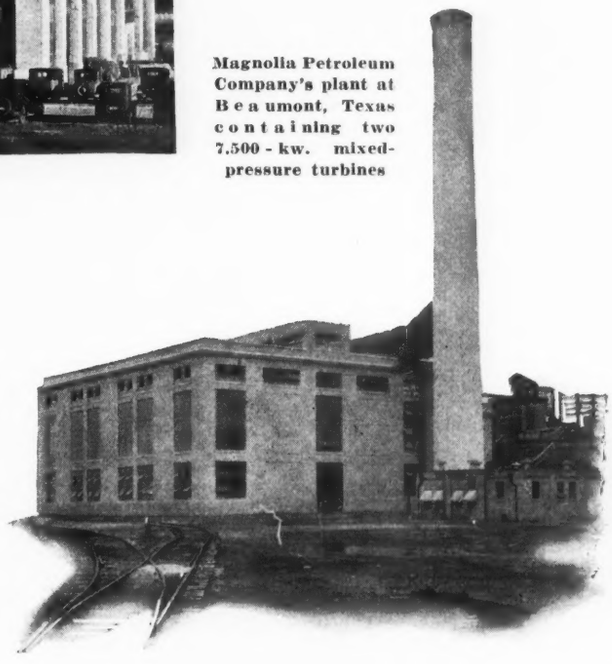
generator 3 (160,000 kw.) occupies 0.0452 sq.ft. per kilowatt. Boilers 1 to 6 (250,000 lb. steam capacity each) occupy 9.2 sq.ft. and 1,140 cu.ft. per 1,000 lb. of steam capacity. Boilers 7 to 9 (1,000,000 lb. capacity each) occupy 4.5 sq.ft. and 625 cu.ft. per 1,000 lb. steam capacity.

Another example of doubling boiler capacity in the same floor space is the new 700,000-lb. unit for the Kips Bay station of the New York Steam Corporation. Older boilers of similar type on the same column centers generate only 325,000 lb. of steam per hour. In an addition to the Hell Gate station of the United Electric & Power Company two boiler units, each designed to produce 800,000 lb. of steam per hour at 285 lb. pressure, but with a probable output approximating 1,000,000 lb., have been installed. Each unit consists of two cross-drum boilers set back-to-back and containing total surface of 52,306 sq.ft. They are equipped with economizers and air preheaters. Pulverized coal is the fuel and the furnaces are provided with air-cooled slag bottoms.

The extension now being made to the Hudson Avenue station of the Brooklyn Edison Company will contain two 160,000 tandem-compound turbine units supplied by eight 530,000-lb. per hour stoke-fired boilers. This will bring the capacity of the station up to 770,000 kilowatts.

That economies are improving is evident from the excellent records of several stations during the year. With steam conditions of 600 lb. and 725 deg. F., working on the reheat cycle and burning 10,000-B.t.u. pulverized coal, Powerton, an Illinois station, consumed 12,455 B.t.u. per kilowatt-hour net output for one month, and over a six-month period averaged 12,610. Weekly averages at Gilbert (Holland, N. J.) 1,200-lb. station were about the same, with a minimum figure of 11,866 B.t.u. The later figure was obtained with a station load factor of 68.39 per cent while burning coal of 14,024 B.t.u. For the year 1929, Long Beach, Cal., Station 3, burning natural gas, averaged 12,850 B.t.u. per kilowatt-hour net output, with a best-day performance of 12,550. Operating on the regenerative cycle at 400 lb. and 725 deg. F., this record was obtained with one 99,000-kw. unit

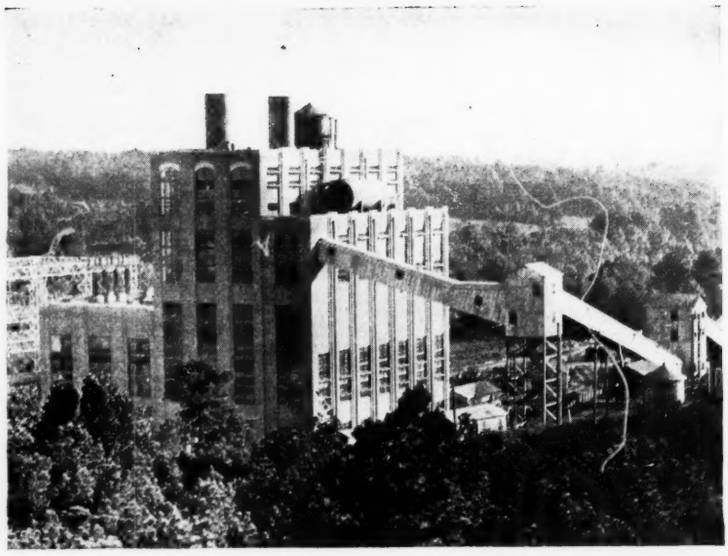


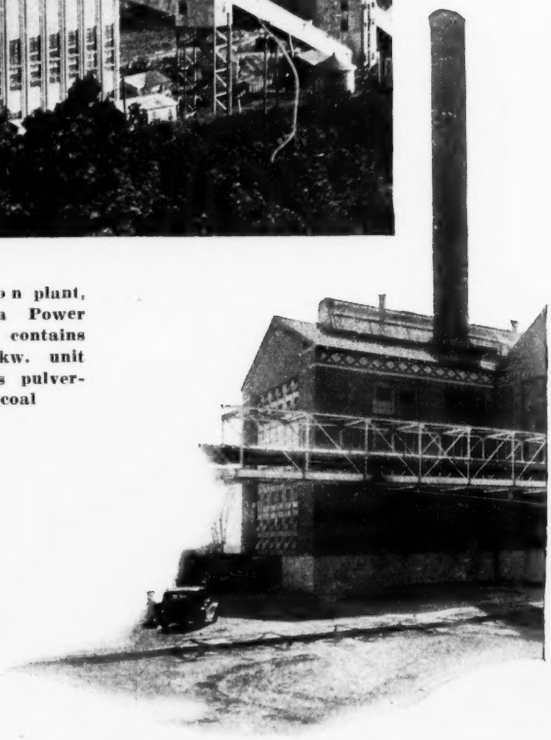


Magnolia Petroleum Company's plant at Beaumont, Texas containing two 7,500-kw. mixed-pressure turbines

running at 90 per cent machine factor. Numerous other stations have shown averages close to 13,000 B.t.u.

Economies actually obtainable by using mercury in a binary-vapor system are indicated by the operating results secured during the year by the Hartford Electric Light Company at its South Meadow station. From Feb. 4 to Dec. 14 this 10,000-kw. unit produced a kilowatt-hour on an average of 10,310 B.t.u. Operation over a period of several days, with a steady load of 9,500 kw. on the mercury turbine-generator, resulted in an average rate of 9,800 B.t.u. per kilowatt-hour net, and established a new record of fuel economy.





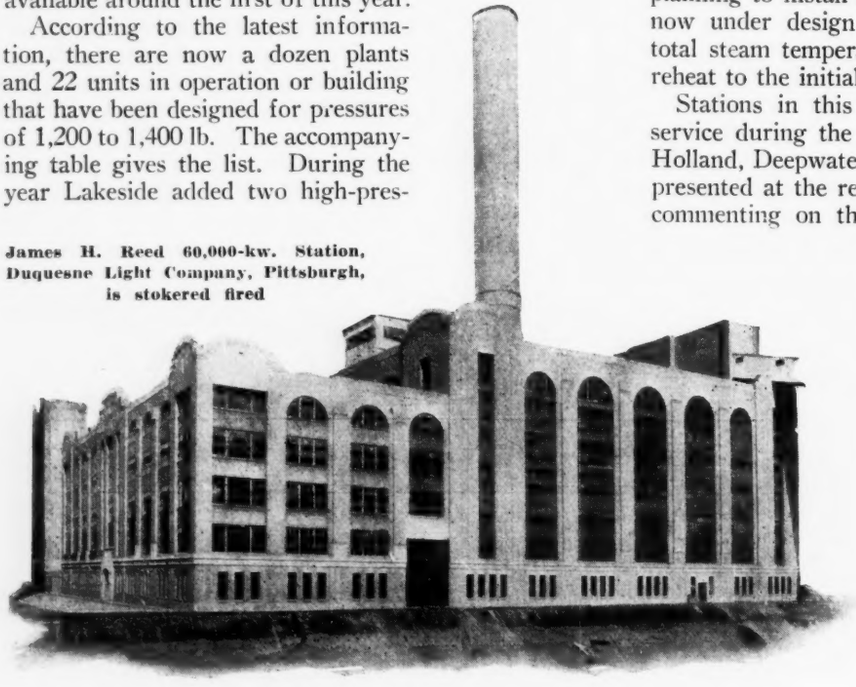
Atkinson plant, Georgia Power Company, contains a 60,000-kw. unit and burns pulverized coal

In steam pressures there has been little change over the previous year. Numerous new plants have adopted the 400-lb. and 750-deg. standard to minimize fixed charges, determining factors being the load, size of unit and relative investment required. Although certain new industrial plants have selected 600 lb. as the primary pressure, utility installations of this class, with reheat, have been principally in the nature of additions to existing plants. When exceeding 400 lb. pressure, the popular choice has been the 1,200-1,400 lb. range. With the exception of certain industrial applications, such as the 1,800-lb. engine plant of the Philip Carey Company now nearing completion, it is probable that the law of diminishing returns will prevent any great increase above this range. A more probable trend is toward the use of higher temperatures, as improvement in metals will now permit progress in that direction. Results from the 10,000-kw. 1,000-deg. unit of the Detroit Edison Company will be received with much interest. This unit has been under construction for two years. The turbine has been in operation on 750-deg. steam since October and the expectation was to have the superheater ready and 1,000-deg. steam available around the first of this year.

According to the latest information, there are now a dozen plants and 22 units in operation or building that have been designed for pressures of 1,200 to 1,400 lb. The accompanying table gives the list. During the year Lakeside added two high-pressure boilers, two 7,700-kw. high-pressure turbines and a 60,000-kw. turbine-generator operating on 300-lb. steam. At Port Washington, Wis., the Milwaukee company is planning to install an initial unit of 80,000 kw. capacity now under design for a pressure of 1,230 lb. and a total steam temperature of 825 deg. F., with interstage reheat to the initial temperature.

Stations in this high-pressure range that went into service during the year are the new units at Lakeside, Holland, Deepwater (N. J.) and South Amboy. Papers presented at the recent annual meeting of the A.S.M.E. commenting on their operation indicated a few initial difficulties common to most new stations, but there was little trouble traceable to pressure conditions. The performances to date justify the design. The Deepwater and Conception Road installations in Texas are additions to existing stations. Both plants use combination oil and natural-gas burners and steam reheaters. Station A of the Pacific Gas & Electric Company is being remodeled to accommodate 1,400-lb. boilers and two 50,000-kw. vertical-compound turbine units. Ultimately the plant will contain four such units, or a

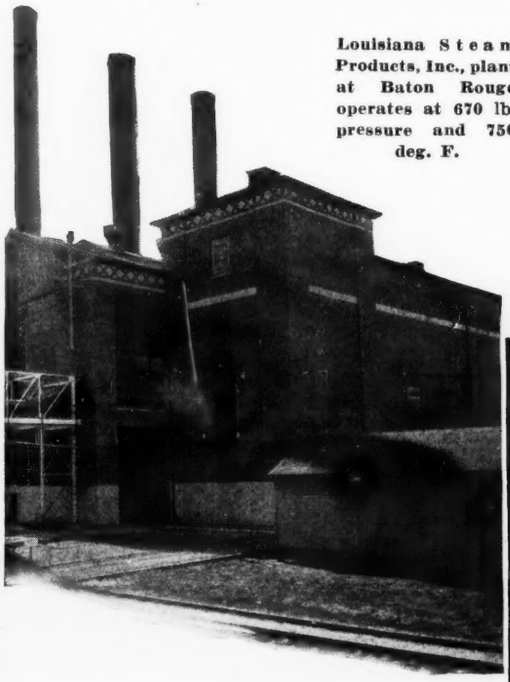
James H. Reed 60,000-kw. Station, Duquesne Light Company, Pittsburgh, is stokered fired



total of 200,000 kw., without increasing the ground area of the original station.

Progress is being made on the high-pressure boiler installation and the 1,200-lb., 110,000-kw. vertical-compound turbine-generator for the River Rouge plant of the Ford Motor Company. In this unit the double-flow low-pressure turbine and generator are respectively beneath the high-pressure turbine and generator. Besides being the largest industrial turbine-generator, the largest vertical-compound machine and the largest turbine-generator to operate on 1,200-lb. steam pressure, except the two units building for State Line, it is also the most compact unit yet built.

Construction work on the second section of State Line



Louisiana Steam Products, Inc., plant at Baton Rouge operates at 670 lb. pressure and 750 deg. F.

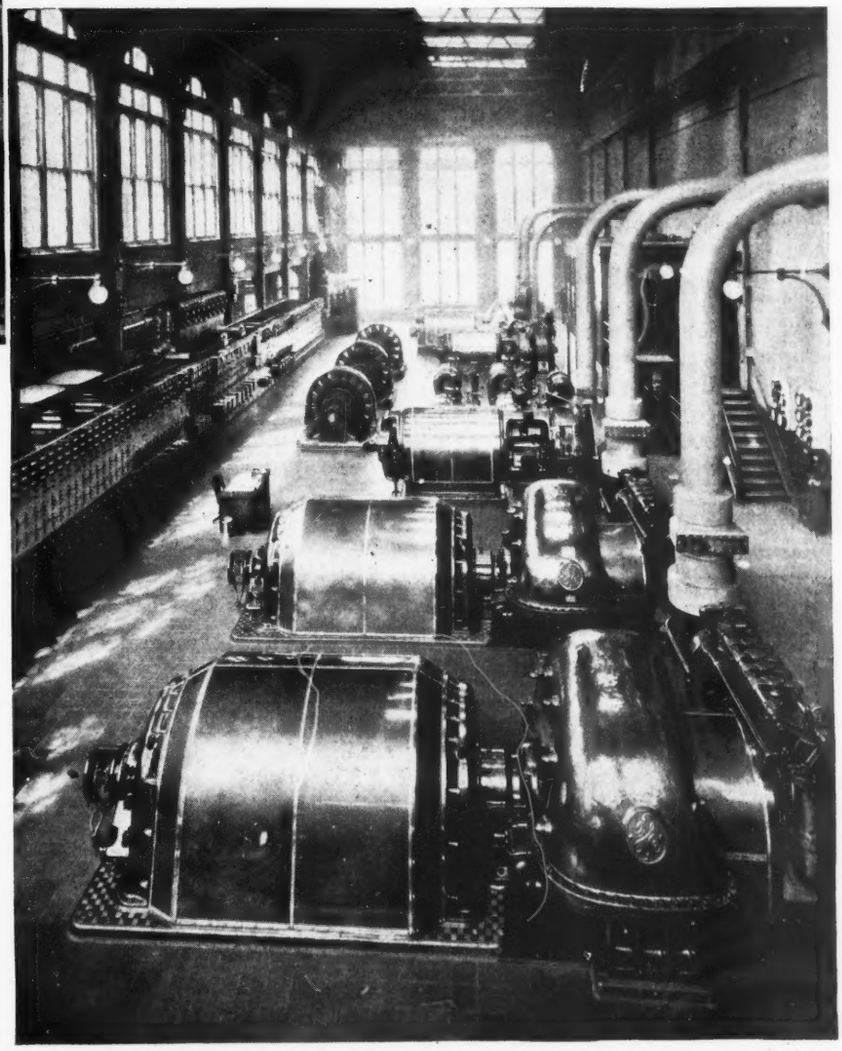
station started in August. Two single-shaft units are to be installed, of 150,000 and 125,000 kw. capacity, that will operate at 1,200 lb. and 825 deg. F. It will be recalled that the first great unit of this station, of 208,000 kw. capacity, operates on 600-lb. steam. There are to be three boilers per unit, one of the reheat type, fired by unit mills. Another innovation will be the reheating to 825 deg. F. of steam at 400 lb. from the high-pressure cylinder and its re-introduction into the high-pressure cylinder for expansion to the cross-over pressure of 15 lb. absolute.

Interrelation between industrials and utilities, the interchange of power on a mutually equitable basis and the joint supply of steam and electricity by the utility are receiving increased attention.

A utility plant of the year designed to generate byproduct power only has been completed at Baton Rouge by the Louisiana Steam Products, Inc., to supply all power and steam requirements of the near-by refinery of the Standard Oil Company of Louisiana. Four boilers, each having capacity to generate 350,000 lb. of steam per hour at 670 lb. pressure and 750 deg. F. deliver to three 15,000-kw. turbines, tied in with the public utility system, which exhaust to process at 140 lb. gage. With boiler make-up approximating 75 per cent, a specially designed feed-water treatment plant has been provided.

Construction is continuing on other plants of this pressure, such as the Northern Indiana Public Service Company's new station at Michigan City, with its initial 68,000-kw., single-cylinder turbine-generator, boilers fired with pulverized coal, and steam conditions of 650 lb. and 750 deg. At the Sheboygan plant of the Wisconsin Power & Light Company the first 30,000-kw. turbine, now going in, will be supplied with steam at 650 lb. and 800 deg. F. by two direct-fired boilers using slag-tap furnaces.

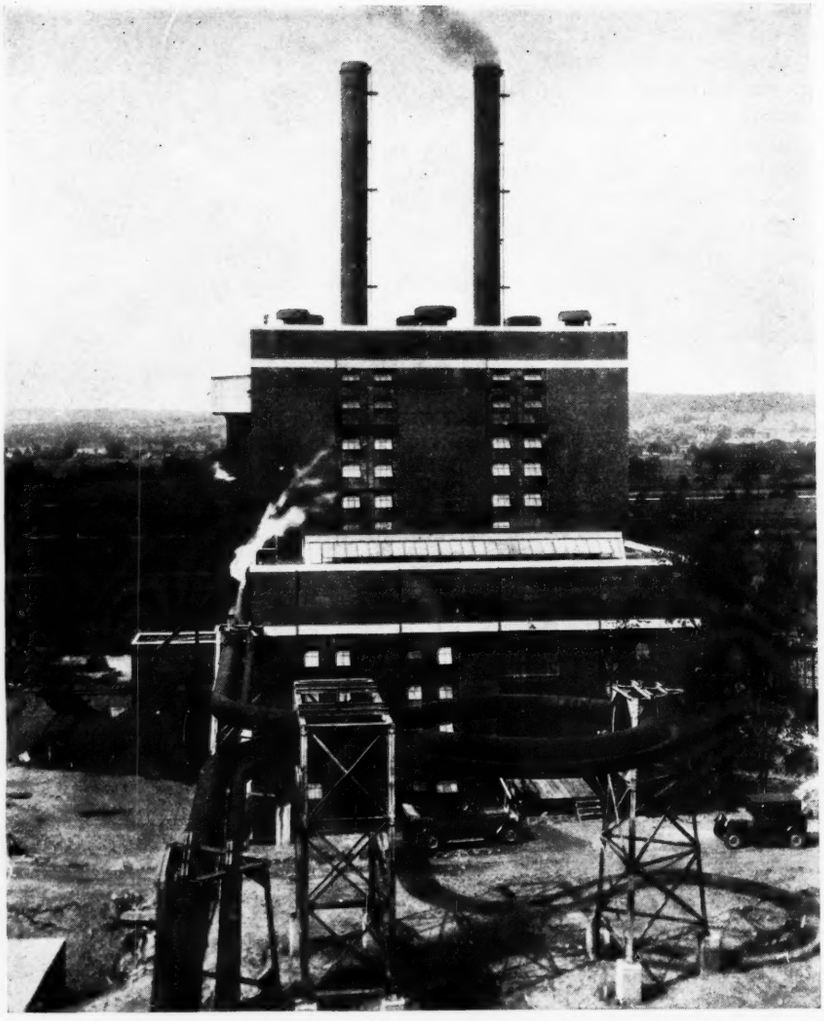
During the year a number of utility plants in which steam conditions, dictated by commercial economy, approximate 400 lb. and 750 deg. F. were completed or are in the course of construction. Space permits reference only to a limited number. The Byllesby Engineering & Management Corporation was responsible for the design of a number of stations built to serve various



Hawthorne plant of the Western Electric Company in Chicago is being rebuilt and changed from 460-volt system to 12,000 volts

subsidiary companies. The most pretentious of these projects is the James H. Reed station of the Duquesne Light Company serving the Pittsburgh district. It has an initial installation of 60,000 kw., and an ultimate of 240,000 kw. is planned. Three stoker-fired boilers operating at 400 lb. pressure serve the turbine.

Another Byllesby station built for the Oklahoma Gas & Electric Company is the new 15,000-kw. Lincoln Beerbower turbine plant. Boilers with forge-welded drums supply steam at 400 lb. and 750 deg. F. The fuel is pulverized petroleum coke. Other points of interest are make-up evaporators and a closed condensate system featured by a surge tank provided with a float and steam-blanketed to guard against contamination of the condensate by oxygen. Practically the same arrangement has been adopted at the new Belle Isle plant of the same company, which closely follows the design of the sister station except that the fuel is natural gas. The 20,000-kw. Minnesota Valley steam station, serving the Northern States Power Company, another Byllesby subsidiary, is of interest in that it was designed for economy operation and then to cut down overhead during the early light-load period of its life, certain equipments were omitted or minimized, with provisions for expansion later. Steam conditions are 350 lb. and 725 degrees.



Skenandoa Rayon Corporation plant, Utica, N. Y., has 8,250 kw. installed capacity

Plant Atkinson, the most recent steam addition to the system of the Georgia Power Company, represents a plant where efficiency has been weighed against initial investment for the service required over a period of years. The initial unit is a 60,000-kw. turbine-generator arranged for four-stage extraction and served by two 450,000-lb. boilers, each equipped with four unit mills. Steam conditions are 475 lb. and 750 deg. F.

Raritan River station of the Eastern New Jersey Power Company, near Sayreville, is another example of a plant designed from the commercial economy viewpoint and for operation at high rating to get the utmost out of the investment. Two 30,000-kw. turbine-generators are supplied with 400-lb., 725-deg. steam by stoker-fired boilers. An outstanding feature is the exclusive use of constant-speed squirrel-cage motors for auxiliary drive arranged for across-the-line starting at 2,300 or 440 volts. A similar plant is being built at Indianapolis by the same holding company, the Utility Power & Light Corporation.

Simplicity was the keynote in the design of the new Ashtabula plant of the Cleveland Electric Illuminating Company, which recently went into service. Like the Avon station of the company, all frills are absent. Two bleed points only have been provided for feed heating. The throttle pressure and temperature of 375 lb. and 700 deg. are moderate, yet the initial capacity of this pulverized-coal plant is 150,000 kw. in three units and the ultimate is 400,000 kilowatts.

During December last the largest single-cylinder turbine was placed in operation at the Charles R. Huntley No. 2 station of the Buffalo General Electric Co. Rated at 80,000 kw., the unit operates at 1,800 r.p.m. on steam of 435 lb. pressure and 750 deg. F. A second similar machine is being installed.

In the new plant of the Lynn (Mass.) Gas & Electric Company the steam conditions selected were 450 lb. and 710 deg. F. The generating unit is a 21,500-kw. turbine. The boilers are stoker-fired. Through reducing valves and desuperheaters steam is supplied to the old plant at 190 lb. and to the gas-works at 125 lb. At El Paso, Texas, the new 43,750-kw. turbine plant of the El Paso Electric Company has turned to natural gas, with oil as a reserve fuel. Here the steam conditions are similar, namely, 450 lb. and 750 deg. From the Public Service Corporation of New Jersey comes the announcement of a new 300,000-kw. plant to be erected at Burlington. The initial installation will consist of two 60,000-kw. turbine-generators.

Other utility plants of the year having points of interest are the Bremo Bluff station of the Virginia Public Service Company, the stoker-fired plant of the Cambridge Electric Light and Power Company, an extension to the Logan station of the Appalachian Electric Power Company, the new medium-pressure natural-gas and oil-burning plant of the Dallas (Texas) Power & Light Company, and the Devil's River plant of the Central

Power & Light Company located at Del Rio, Texas.

On the Pacific Coast construction of a 50,000-kw., 1,450-lb. steam plant to use natural gas or oil as fuel is under way for the San Joaquin Light & Power Corporation, of Fresno, Calif. There will be no housing over the boilers. The City of Tacoma, Wash., is building a 25,000-kw. plant to supplement the hydro-electric developments at La Grande and Lake Cushman. At Portland, Ore., a 35,000-kw. addition to the generating capacity of Station L has been made by the Pacific Northwest Public Service Company. The new 35,000-kw. oil-fired turbine plant of the Great Western Power Company in San Francisco also was completed. Special automatic control to provide emergency stand-by service is the interesting feature. The unit is kept warm and turning over at all times as a synchronous condenser, so that it may be brought into emergency service in a few minutes.

New Industrial Power Plants

In the industrial field a number of new plants have been completed. To increase byproduct power recovery there is a trend toward higher pressures, ranging for the most part from 300 to 600 lb., with the majority selecting 400 lb. as the pressure best suited for the conditions existing. Full advantage is being taken of improved bleeder turbines, and the number of extraction stages used is increasing. The choice between pulverized coal and stokers is about evenly divided. Greater effort is being made to balance power and process steam. In certain plants only byproduct power is generated and the balance of the electrical requirements purchased. In a few cases dependence is placed on an accumulator to maintain the balance. Space is available to mention only a few of the typical industrial plants.

An outstanding example of balanced design is the Crocker, Burbank station serving three paper mills in Fitchburg, Mass. Steam at 400 lb. and 645 deg. is supplied by unit-mill-fired boilers to turbine-generators exhausting at 35 lb. to process. Full utilization of byproduct power is made possible by a utility connection which absorbs all of the power generated in excess of the mill requirements.

Balance again is a leading factor at the reconstructed plant of the Proximity Manufacturing Company, Greensboro, N. C. The new plan of supplying power and process steam includes generation of steam at 450 lb., development of power in bleeder turbines and conveyance of 150-lb. bled steam a distance of half mile, where the steam is put through a second turbine and then withdrawn at 13 lb. for process. These two plants are electrically connected with a third.

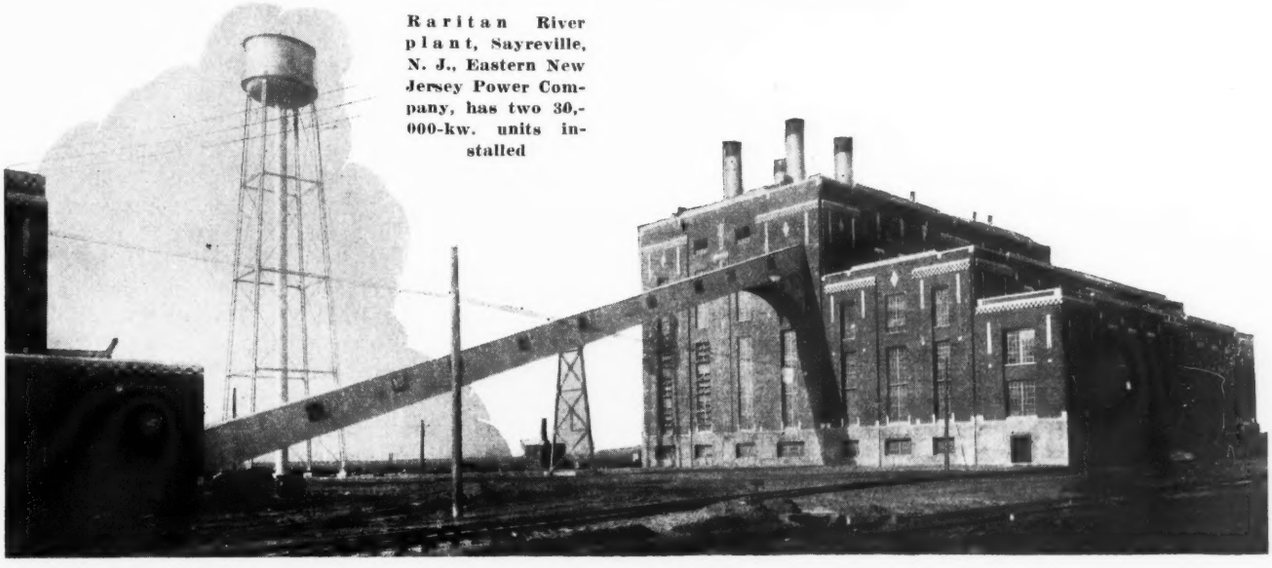
Paper Mills Use High Pressures

At the pulverized-coal turbine plant of the Waldorf Paper Products Company in St. Paul, Minn., balance between power and process steam and the maintenance of pressures are secured with an accumulator. The initial pressure there is 650 lb. and back pressures on the turbines 70 and 44 lb. In the new Anheuser-Busch plant in St. Louis, Mo., 465-lb. boilers supply noncondensing turbines that generate all the power required while bleeding at 150 lb. to process through an accumulator and exhausting at 5-lb. pressure.

Another variation in the method of balancing is to be observed in the new single-boiler single-turbine plant of the Champion Coated Paper Company in Hamilton, Ohio. Four duplex pulverizers serve a 27,192-sq.ft. boiler supplying steam at 600 lb. and 750 deg. F. to a 20,000-kw. three-element turbine with new high- and intermediate-pressure machines and an existing low-pressure turbine. Steam from the high-pressure element is exhausted at 175 lb. to the intermediate turbine and to process. Bled at 90 lb. for feed-water heating, the intermediate element exhausts at 15 lb. to process and to the low-pressure element, which is equipped with a condenser. In summer the low-pressure machine carries only a small fraction of the load, and during the heating season it is not needed.

Another paper mill employing 600 lb. steam is the Tyrone plant of the West Virginia Pulp and Paper Company. Here a 5,000-kva. non-condensing turbine exhausts at 180 and at 20 lb. to process lines. The 180-lb. line also supplies existing condensing turbines which bleed to the 20-lb. line.

A new plant of the New Brunswick International Paper Company, Dalhousie, N. B., Canada, has a 6,000-kw. turbine that operates in parallel with an 80,000-hp. hydro plant at Grand Falls, 110 miles away. The hydro plant is the major source of power for the mill. The turbine has sufficient capacity to supply the essential equipment to keep the paper machines operating in case of a failure on the single-circuit transmission line. Steam at 425 lb. and 225 deg. superheat is used



Raritan River plant, Sayreville, N. J., Eastern New Jersey Power Company, has two 30,000-kw. units installed

and the turbine operates as a reducing valve to supply steam at 125 lb. gage to the mill. Pulverized coal is burned under the four 12,000-sq.ft. boilers.

At the Restigouche pulp mill of the Frasers Companies, Ltd., Athols, N. B., both power and process heat are supplied from three 350-lb. 1,000-kw. turbines. Two of the turbines operate non-condensing and are bled at 120 lb. gage, and one operates condensing. A steam accumulator is installed and the plant is so designed that although the load varies widely the boilers are operated at practically constant steaming rate.

In the Gatineau plant of the Canadian International Paper Company, Gatineau, Que., four 13,000-sq.ft. boilers have been installed. The boilers are designed for 200 lb. pressure and operate in parallel with an electric steam-generator plant that has been supplying the total steam for a 600-ton pulp and paper mill. Part of the power that formerly was used in the electric-steam generators is now being sold for other purposes.

At Erie, Pa., the Hammermill Paper Company installed an alternating current direct-current engine-generator unit to secure a heat balance. The paper machine is driven by power from the direct-current generator, and, with the alternating-current machine operating in parallel with the main turbine-generators, the load is adjusted so that the engine exhaust is just sufficient to meet the requirements of paper drying.

A new plant was completed for the Skenandoa Rayon Corp. at Utica, N. Y., containing two pulverized-coal-fired boilers equipped with flooded-type economizers and air heaters. These boilers supply one 3,750-kva. bleeder, condensing turbine, one 3,750-kva bleeder non-condensing turbine and one non-bleeder condensing turbine.

Oil Refinery Plants

Oil refineries are taking advantage of byproduct power recovery from the great quantities of steam needed for process. At the Beaumont, Texas, plant of the Magnolia Petroleum Company two 7,500-kw. double extraction and mixed-pressure turbines exhaust at 150, 25 and 10 lb., and take steam at 25 lb. Initial steam conditions are 385 lb. and 650 deg. F. The boilers have been designed for initial operation with natural gas, fuel oil or acid sludge, and provision has been made for the later installation of equipment for pulverizing and burning refinery coke.

At the Wellesville, N. Y., refinery of the Sinclair Refining Company a new 400-lb. 550-deg. steam plant is progressing rapidly. Pulverized-coal boilers will supply two 750-kw. non-condensing turbines that will exhaust at 125 lb. to process.

An interesting hook-up has been made by the Paraffine Companies, Inc., in a new plant at Emeryville on San Francisco Bay. A 2,500-kw. non-condensing turbine takes steam at 425 lb., bleeds at 150 and exhausts at 40. The turbine operates in parallel with a system of reducing valves to supply process, and the generator is connected in parallel with an outside source of power. The power generated is governed by the amount of bled and exhaust steam drawn from the turbine, and under certain conditions power may be pumped into the outside system. Evaporators serve the dual purpose of providing pure make-up water and functioning as equivalent fractional condensing capacity. That is, a varying demand for 40-lb. exhaust steam from the turbine may be created by operating the evaporator triple, double, or single effect.

In the new chemical plant of the Tennessee Eastman Corporation at Kingsport, Tenn., a non-condensing turbine and reducing valves transform 450-lb. boiler steam to 90 and 10 lb. pressure for process use. A portion of the 90-lb. steam passes through an older turbine, and the load balance is such that a constant flow of the exhausted 10-lb. steam is passing back to the new plant.

Another plant combining process and power is the new Lucky Strike Cigarette power plant at Richmond, Va. Here two 1,000-kw. turbines take steam at 400 lb. and exhaust into process lines at 90 lb.

The Western Electric Company has two interesting developments, one the remodeled plant at Hawthorne, and the other the new Point Breeze plant, built with a modern boiler installation with provision for future generating equipment, and later leased to the Consolidated Gas, Electric Light & Power Company, of Baltimore, which now sells power and steam for process to the industrial. Both these plants were described recently in *Power*.

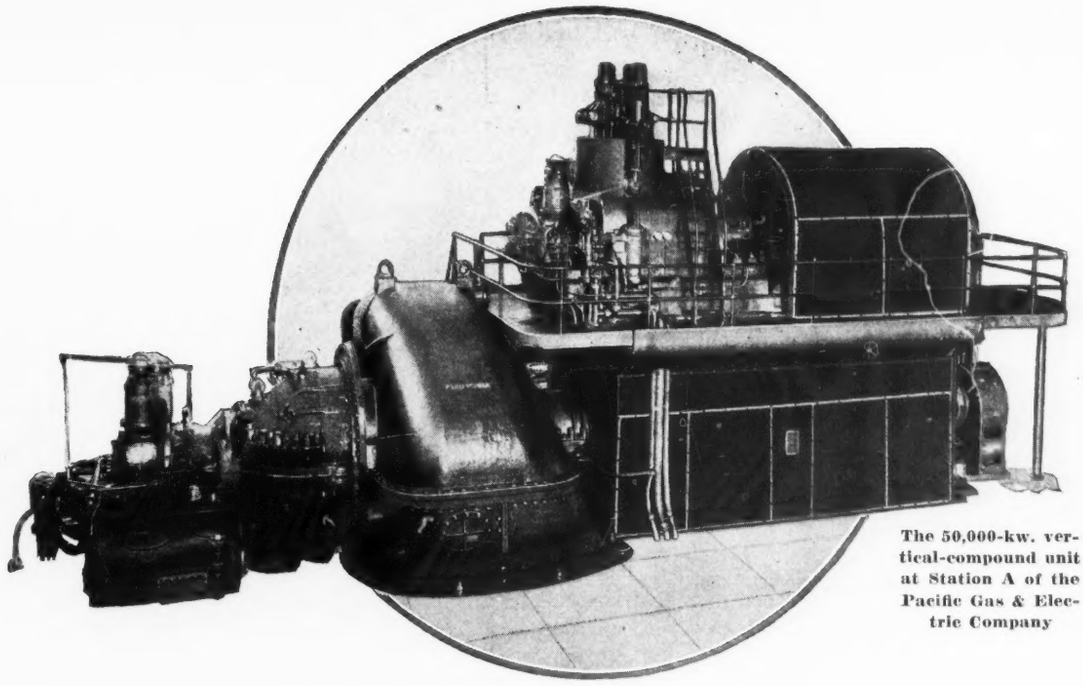
Continuing the enumeration, there is the new plant now under construction for the New York Hospital-Cornell Medical Associates, which will have oil-fired boilers and four-valve engines, each driving on one shaft a 12,500-kw. alternating-current generator and a 3,500-kw. direct-current generator; the Waterbury Clock Company plant in Connecticut, which burns crushed coal in suspension; the modern boiler plant of the General Steel Castings Corporation at Eddystone, Pa.; the new pulverized-coal heating and power plant for the Bureau of Standards at Washington; the modern 4,000-kw. wood-refuse-burning plant of the Edward Hines Western Pine Company, near Burns, Ore.; and the Springwells pumping station and power plant at Detroit, which is heralded as the largest single pumping station in the world.

In the central station heating field mention should be made of the new Kneeland Street Heating Plant of the Edison Electric Illuminating Company, which went into service late in the fall of 1930. This contains two 19,030-sq.ft. pulverized-coal-fired boilers employing air preheaters. Turbines drive the mills, fans and other auxiliaries.

Floating Power Plant

Another interesting development of 1930 was the completion of the first floating power plant designed solely to produce power for outside use. The steamship "Jacona," with a generating capacity of 20,000 kw., was placed in service by the New England Public Service Company of Augusta, Me. In its first application it was tied to a dock at Bucksport, Me., where a large tidewater paper mill is in the course of construction. This mill will require 20,000 hp., which will be supplied by the "Jacona" until the Wyman Dam plant at Bingham is completed. None of the power of this ship is available for propulsion. It is towed from port to port as the need arises.

The "Jacona" is equipped with four boilers with a combined capacity of 280,000 lb. of steam per hour at 425 lb. pressure and 250 deg. F. superheat. Two 10,000-kw. turbine generators (bled from fourth, seventh and tenth stages) are installed. Connection to shore is made through two separate three-phase circuits, consisting of heavily armored and insulated cable. These are swung loosely between steel towers, one on the "Jacona" and one on shore.



The 50,000-kw. vertical-compound unit at Station A of the Pacific Gas & Electric Company

Trends in Steam Prime Movers

Are toward tandem-compounds, higher temperature and larger-capacity high-speed units

ALTHOUGH, during the past year, orders were not given for turbine units larger than the 208,000-kw. unit at State Line, which has now been in service for nearly two years, nevertheless there is still a definite trend toward large units.

The two 105,000-kw. units for Powerton, the 115,000-kw. unit for Waukegan, and the 110,000-kw. unit for the Ford plant, reported on order in last year's review, are expected to go in operation early this year. During the past year the number of turbines of over 100,000-kw. capacity was increased by four new orders, two 160,000-kw. units for Hudson Avenue, and two units for State Line, one a 150,000-kw. unit and the other of 125,000 kilowatts.

Three large units have been placed in operation, a 110,000-kw. at the Hudson Avenue Station of the Brooklyn Edison Company, a 94,000-kw. tandem-compound at the Long Beach station of the Southern California Edison Company, and an 80,000-kw. single-cylinder unit at the Huntley station of the Buffalo General Electric Company. The latter unit is now the largest single-cylinder turbine in operation. That at Hudson Avenue is practically a duplicate of the one placed in operation in September, 1928.

For turbines of these large capacities utilities apparently have a decided preference for single-shaft tandem-compound machines. Of the eight units of over 100,000-kw. capacity that are under construction, all are tandem-compound but one, an industrial 110,000-kw. vertical-compound (superimposed type) unit being built for the Ford Motor Company. This turbine, it is reported, will be placed in the same building with the same spacing between units as had been used with the 12,500-kw. turbines. Evidently the simplicity and reduced station investment are considered to offset the slight gain in efficiency that is possible with cross-compound units.

For the first time in this country there is definite indication of an increase in steam temperature above the 750 deg. that has been the limit for so many years. Four of the large turbines on order are designed for 825-deg. steam at 1,200-lb. pressure. This represents the highest steam temperature so far attempted by American manufacturers, although for short periods many turbines have run at this or higher temperatures in actual service. The mercury-vapor unit at Hartford, however, is operating at 880 deg., but only at about 70-lb. pressure.

The high-temperature, 10,000-kw. British turbine being installed at Delray No. 3 of the Detroit Edison Company has not as yet gone into operation at high temperature.

In last year's review it was pointed out that the economic pressure range would be definitely affected by any development that made higher temperatures practicable. Heretofore central-station practice has fallen into three groups, one carrying steam pressures up to and including 450 lb. without reheat, the second employing pressures

of 600 to 700 lb. with reheat, and the third employing pressures with reheating in the 1,200 to 1,400-lb. range. Now a 30,000-kw. unit has been ordered for the Sheboygan plant of the Wisconsin Power & Light Company designed to operate at 650 lb. pressure and 800 deg. temperature, without reheat. The increase in temperature to 800 deg. thus raises the pressure limit of non-reheating plants to 650 pounds.

New High Pressure Turbines

Five new turbines in the 1,200-lb. pressure range are on order. Outstanding among these are the 150,000- and 125,000-kw. tandem-compound units for State Line, and an 80,000-kw. tandem-compound for the Anderson station of the Milwaukee Electric Railway & Light Company. The other two are 3,600-r.p.m. machines, a 7,600-kw. unit for the San Antonio Public Service Company and a 7,700-kw. for Lakeside. The 150,000-kw. unit is a three-cylinder machine and the largest 1,200 lb. turbine so far designed.

Five of the high-pressure turbines reported last year as under construction have been placed in regular operation. These comprise the two 53,000-kw. and the 12,500-kw. units at Deepwater, the 50,000-kw. turbine at Gilbert, and the 25,000-kw. vertical-compound machine at South Amboy. The duPont unit at Deepwater has given trouble because of silica scale depositing on the blades and nozzles. This scale had to be scraped off by hand. The turbine-governing mechanisms at both Deepwater and Gilbert caused some difficulty from sticking, but this is reported to be cured. Trouble from deposits on turbine blading has been encountered at other plants, but in all other cases the deposits are soft and easily washed off.

The 50,000-kw. vertical-compound high-pressure units for Station A and the 3,700-kw. high-pressure machine for the Dow Chemical Company are expected to go in operation early this year. The high-pressure element of the vertical-compound unit is to operate at 3,600 r.p.m. and has a capacity of 12,500 kw. The low-pressure element is rated at 37,500 kw. and is to operate at 1,800 r.p.m.

Units of 3,600 r.p.m. are receiving greater attention. Two 3,600-r.p.m. tandem-compound machines of 15,000-kw. capacity each have been ordered by the Virginia Public Service Company. They represent the largest turbines of these sizes attempted by American manufacturers. Shorter bearing span and lighter turbine rotors are claimed to give this type of unit distinct operating advantages with regard to quick starting. There is a 15,000-kw., 3,600-r.p.m. unit in operation in Europe. One American manufacturer is prepared to build machines of this speed up to 25,000 kw. capacity.

The 10,000-kw. mercury vapor turbine at the South Meadow plant of the Hartford Electric Light Company, after changes made on diaphragms and their support, has been in regular service since Feb. 4, 1930. Its operation has been satisfactory.

Some improvements in turbine efficiencies are noticeable. Tests reported on a three-cylinder tandem-compound 85,000-kw. Brown-Boveri turbine for the Zschorniwitz plant, Germany, indicate an efficiency of 87.7 per cent, based on shaft output at the coupling. This is believed to be the highest efficiency so far achieved.

Progress has been made toward securing flatter steam rate curves, but at the expense of increased complication in governor design. The efficiency of the high-pressure element of high-pressure turbines has been increased by a greater number of stages and longer buckets, so that its efficiency is nearly equal to that of the low-pressure.

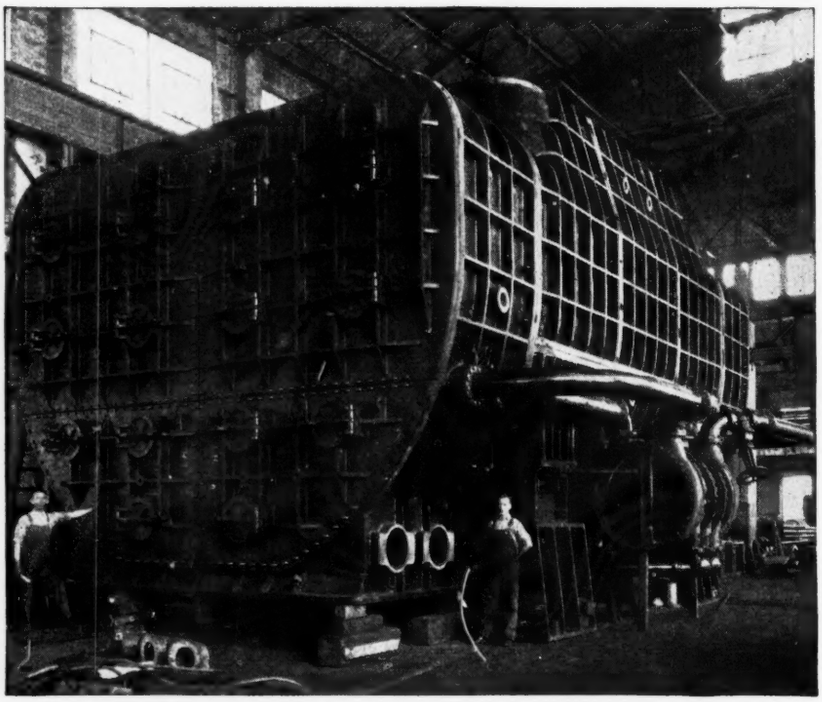
Efforts have been made to increase the amount of moisture removed at the bleed points and last stages. Complete moisture removal would improve efficiency and decrease blade erosion in the last stages, but its accomplishment does not seem probable at present.

Researches in Blade Materials

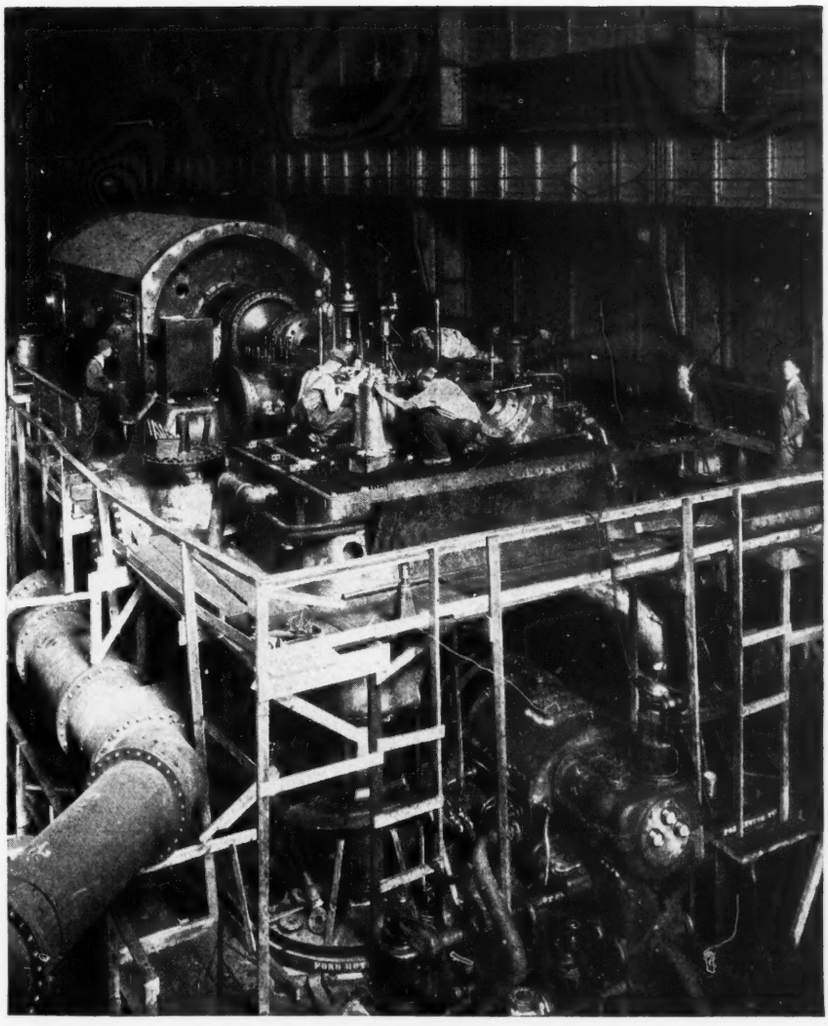
High-speed, low-pressure blades have shown increased rates of wear, and manufacturers are conducting researches with respect to blade materials for low-pressure service. Chromium plating, nitrided material and wear-resistance shields of metals, such as tungsten and tantalum, are being tried.

Despite these efforts, blading and nozzles still are the main source of turbine troubles. Considerable improvement was indicated by the 1930 Prime Movers Report on turbines, which showed a reduction of 33 per cent in turbine outages due to blade and nozzle trouble.

In the field of industrial turbines there has been an increase in the use of back-pressure and mixed-pressure bleeder units and other combinations adapted to give complete heat balance for both summer and winter conditions. This has resulted in development of special governing mechanisms designed to take care of individual requirements. An 18,000-kva. turbine-generator, which



This single-pass 80,000-sq. ft. condenser for the 105,000-kw. units at Powerton has built-in hydraulic valves that reverse the water flow for cleaning the tube sheet



Assembling the 110,000-kw. vertical-compound Ford unit for shop tests

is unusually large for an industrial plant, has been installed by the Youngstown Sheet & Tube Company.

One manufacturer has developed a new design primarily for high-back-pressure turbines applied to modern existing low-pressure plants. The outstanding feature is the casing, which is of cast steel with each half in one piece. The steam chest and high-pressure head are integral with the wheel casing, and joints other than the horizontal are avoided.

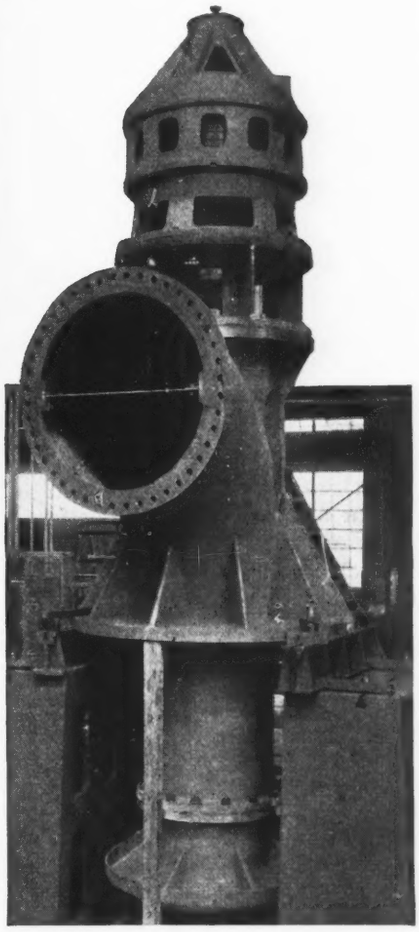
Turbine drives for forced- and induced-draft fans are being considered favorably by some designers. One manufacturer has developed an automatic nozzle control for its small turbines which is especially adapted to combustion control equipment. At Hell Gate station the induced- and forced-draft fans are driven, respectively, by the high- and low-pressure elements of cross-compound axial flow Ljungstrom type turbines. This will be described in an early number of *Power*.

One turbine builder is of the opinion that in the field of auxiliary units, price is more significant over steam rates than it has been in previous years.

Condensers and Auxiliaries

The trend reported last year toward condensers with tubes rolled into the tube sheet at both ends continued during 1930, and no trouble due to this construction has been reported. This development, originally brought out to prevent contamination of the condensate in high-pressure plants, is now finding favor in lower-pressure installations. Two methods are in use for taking care of expansion, floating tube sheets and bowed tubes. A manufacturer who makes condenser tube packing has developed a method for rolling in tubes that had previously employed ferrules and packing. It is claimed this can be done at a total cost not more than the expense of corset lace packing, fiber ring and ferrules.

Orders have been placed for two of the largest single-shell single-pass



One of two 40,000-g.p.m. vertical-propeller-type circulating pumps for the James H. Reed station

condensers. Each of these has a nominal surface of 101,000 sq.ft. and will serve the 160,000-kw. units on order for Hudson Avenue. The 80,000-sq.ft. single-pass condensers for the 105,000-kw. Powerton turbines are fitted with hydraulically operated valves built into the waterboxes, eliminating the need of outside piping. They permit the operators to reverse the flow of circulating water for the purpose of removing dirt that collects in the tube inlet ends.

A number of orders have been given for all-welded condensers. Three of these are for moderate-sized units, one a single-pass 29,000-sq.ft. condenser for Riverside Station serving a 35,000-kw. turbine, and two for the Illinois Steel Company, of 11,500-sq.ft. surface and serving 10,000-kw. turbines. These orders are evidence

of the marked interest taken in welded condensers as last year was announced the pioneer installations of a 27,000-sq.ft. single-pass unit for the Parr Shoals plant.

The best location of air offtakes is still a matter of contention among condenser builders. One manufacturer sectionalizes the condenser and provides for air removal from each section. On the other hand, another manufacturer, contending that the natural flow of steam is toward the cold end, has located the air take-off at the cold end and has provided passages for the flow of air and steam to this end.

This represents a new thought in the theory of condenser design and the performance of condensers in which this theory is incorporated will be of interest.

Chlorination of condenser circulating water for the purpose of keeping the tubes clean has received considerable attention, and a number of stations have adopted this method. One company has had satisfactory cleaning experience with a blast of pulverized coal ash and sand, the ash preventing the erosion of the tube but not hindering the cleaning effect of the sand.

The water mixture found best consisted of three parts of pulverized fuel ash and one part of sand. The mixture is forced through a nozzle held up against the tube inlet. Three men with two nozzles working for six hours can clean 10,000 tubes.

Efforts have been made to improve the seals of condenser pumps so as to prevent air from entering the feed- and circulating-water systems. An outstanding circulating-water pump installation was made at the James H. Reed station, where two 40,000-gal. per minute vertical propeller-type pumps are in operation. They are driven by 350-hp. vertical motors. A best-point efficiency of about 85 per cent was secured on test. Four 157-750-gal. per minute pumps of the same type have been shipped to the Ford Motor Company for booster service in its River Rouge condenser circulating water system.

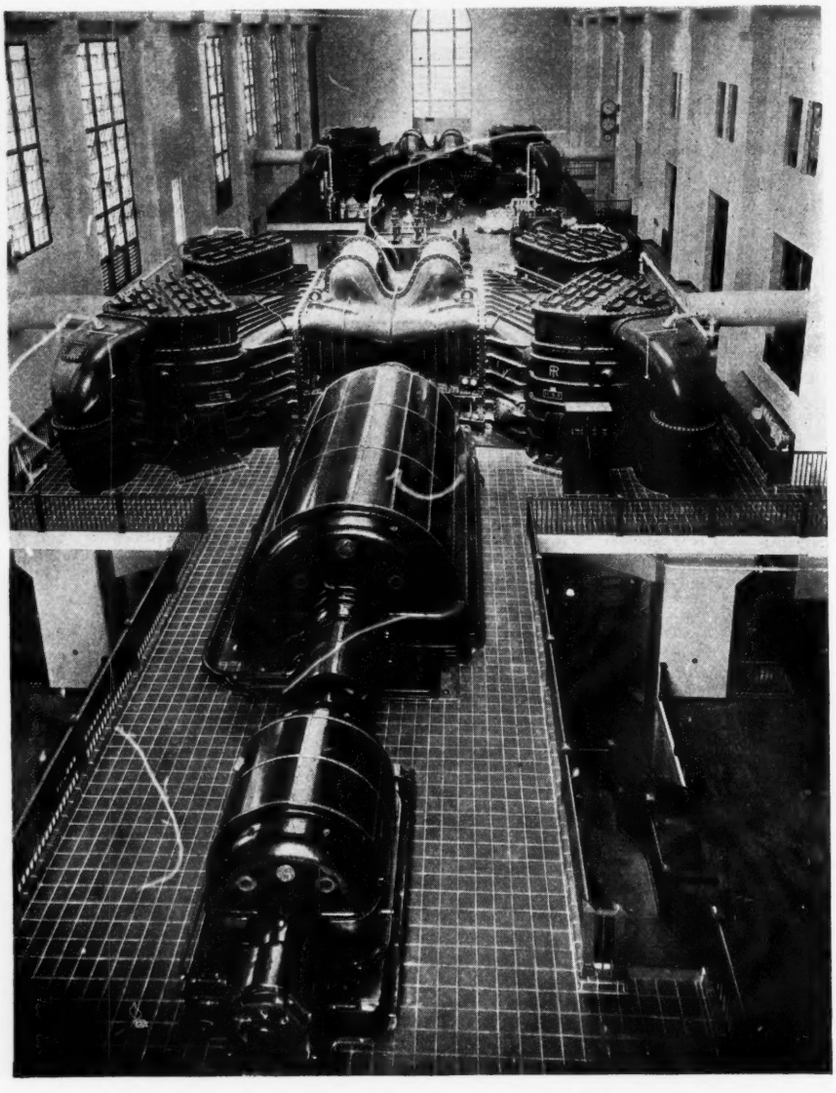
Steam Engine Activities

Outstanding in the field of steam engines are four 6,700-hp. compound engines that were ordered in 1929 and built in 1930 to drive five-stage hydrogen compressors. These engines are designed to operate with steam at 390 lb. per square inch pressure and 650 deg. temperature.

In spite of the fact that the crank and flywheel pumping engine has been practically eliminated by other types, due to its high investment cost, during the year an order was placed for such an engine to deliver 10,000 g.p.m. of water against 600 lb. pressure.

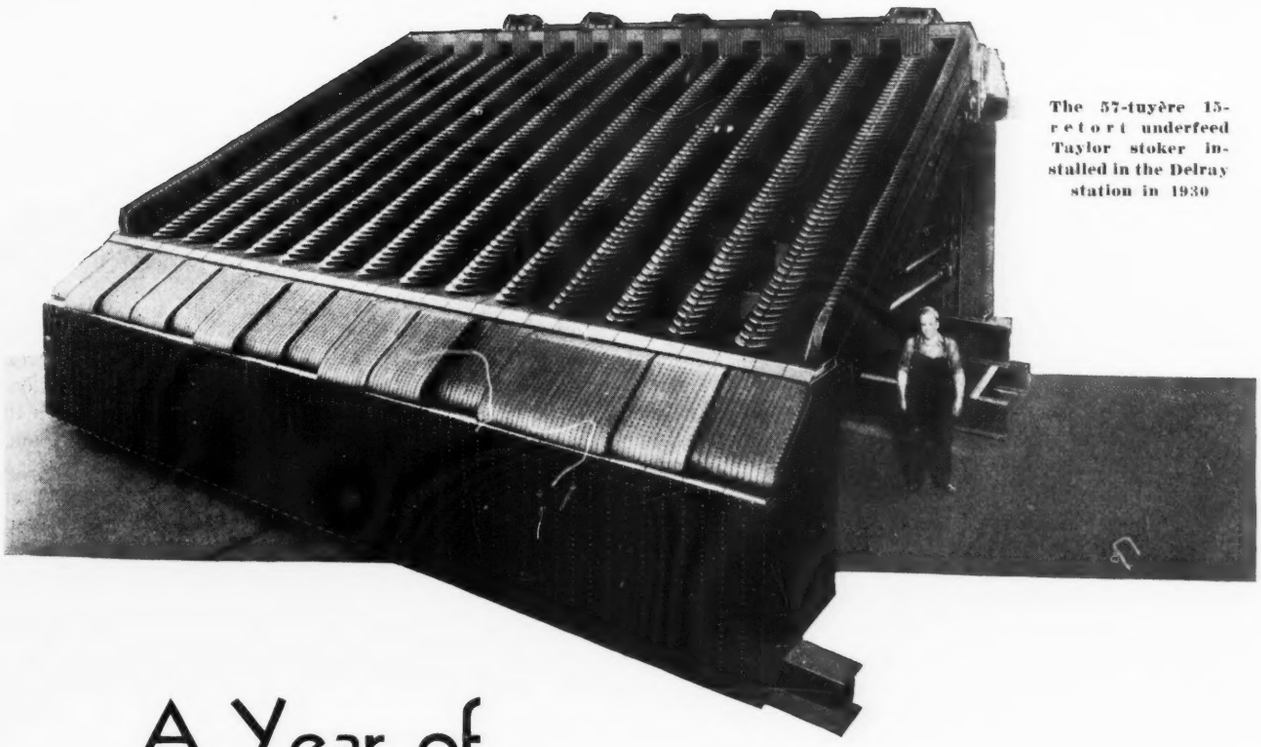
The two vertical 6,000-hp. triple-expansion engines built abroad for the 1,400-lb., 797-deg. Philip Carey Company power plant have been installed but have not yet gone into operation. It is expected that the plant will be started up early this year.

Engine builders have enjoyed a relatively active year, with installations in a wide variety of plants. These include the power plants of hotels, office buildings, department stores, hospitals, a brick plant, color manufacturer and clubhouse. Outstanding among them are three 2,500-hp. engines under construction for the Cornell Medical Center, New York City, and three other units of the same horsepower for the Pilgrams State Hospital at Brentwood, L. I. The engines for the Cornell Medical Center will each drive a 1,250-kw. alternator and a 350-kw. direct-current generator. Sixty cycles is automatically maintained by a Telechron clock on the engine governor.



Turbine room of Plant No. 3, Long Beach, showing the recently added 94,000-kw. turbine generator

Builders are inclined to be optimistic over the steam engine future. It is claimed that building and factory owners are recognizing the advantage of generating power from steam going to process and heating; frequently the savings in the winter months far exceed the additional cost of power during the summer non-condensing operation, and some of the engine builders are offering to install such steam engine equipment on a "pay-by-saving basis."



The 57-tuyère 15-retort underfeed Taylor stoker installed in the Delray station in 1930

A Year of Competitive Fuels

1930 marked the extensive use of natural gas as power boiler fuel. Coal burning was marked by the production of a 40-ton unit pulverizer and a 69-tuyère stoker

COAL, especially bituminous, has so long been regarded as the power fuel that no marked change in basic fuel is expected. However, opening up of the California and Southwestern gas fields and consequent building of long gas-distribution lines has somewhat upset the fuel-supply structure. The chief sufferer has been the oil industry, for not only have a number of large central stations and industrial plants along the Pacific Coast turned from oil to gas, but the same conversion has occurred in the Southwest and South, which has reduced the consumption of boiler oil and seriously embarrassed the refineries. To make the burden of woes more pronounced, new plants have adopted natural gas as the fuel.

Fuel oil, however, has not been the only sufferer, for in many instances users of bituminous coal have turned to gas, and in Ohio building-heating plants have installed gas-burning equipment because of its cleanliness, even at an advance in fuel costs. As a further disturber, there is a likelihood that Chicago central stations will burn gas pumped from the Southwest during hours when the domestic gas load is small, to maintain a high load factor on the pipe line.

At present gas lines reach both San Francisco and Los Angeles and intermediate towns. Lines extend from the New Mexican fields to the mining towns of Arizona, and Texas is fairly cobwebbed with gathering lines and mains. In the South lines run from Louisiana to as far east as Atlanta, Ga. In addition Memphis, Tenn., is supplied from the same field, and gas is an active competitor of coal. St. Louis, Mo., and nearby Illinois towns are the terminals of a line from Louisiana. A network of gas lines covers Kansas, and a new one is being built through Kansas and Missouri, being now about 70 miles west of St. Louis. Farther eastward a line is projected from Kentucky to Toledo. Finally, active work is being done on the line from Texas to Chicago.

Bituminous coal mined during the year totaled 449,619,000 tons against 521,145,000 in 1929. This decrease is due to the business depression, less coal consumed by the railroads and inroads of natural gas. The output of crude oil was approximately 377,307,000 barrels.

In a number of instances furnaces have been built to burn any one of a number of fuels, separately or in combination. Both gas and oil is being handled by a single burner, while pulverized coal and hogged fuel or pulverized coal and gas or oil are combinations used in several plants. One interesting application was the development of a mechanical oil burner to handle refinery sludge.

The physical handling of steam coal from the car to the power house bunker has shown no marked advance. But improvements have been made in conveying-equipment materials to reduce wear and abrasions, and in details of existing machine designs. There is evidence of a trend toward drag scrapers, as over 50 per cent of the new plants in 1930 employed this method.

Stoker and Pulverizer Sales

According to the Department of Commerce the sales of coal-burning equipment for the first ten months of the year were: Stokers, 3,328,350 sq.ft. of boiler heating surface, and pulverizers, 2,357,500 sq.ft. of boiler surface. This indicates that the stoker is still holding its own. Smoke-abatement agitation in many cities has had a favorable influence on stoker installations in place of hand firing in smaller plants. This is particularly true in heating plants, where the development of small stokers makes possible the elimination of hand firing. Both underfeed and chain-grate stokers of small capacities were introduced during the year. And as the smoke nuisance is most pronounced in the high-volatile coal districts, the small chain-grate designs have made rapid strides.

Increased capacity has featured the design of underfeed stokers. The largest units so far ordered are underfeeds for eight boilers in the Hudson Avenue station of the Brooklyn Edison Company. Each boiler has a capacity of 530,000 lb. of steam per hour; each stoker is 69 tuyères long and has 15 retorts, with a fuel bed of 694 sq.ft.

A novel development brought out during the year was a submerged clinker grinder. It prevents any gas, vapor or dust from polluting the air in the basement. The grinder rolls, being submerged, are protected from damage by heat, and therefore maintenance is reduced. The ash is ground under water and settles to the bottom, remaining there until sluiced out. Air cannot enter the furnace except under control, and the gases of combustion are prevented from entering the pit.

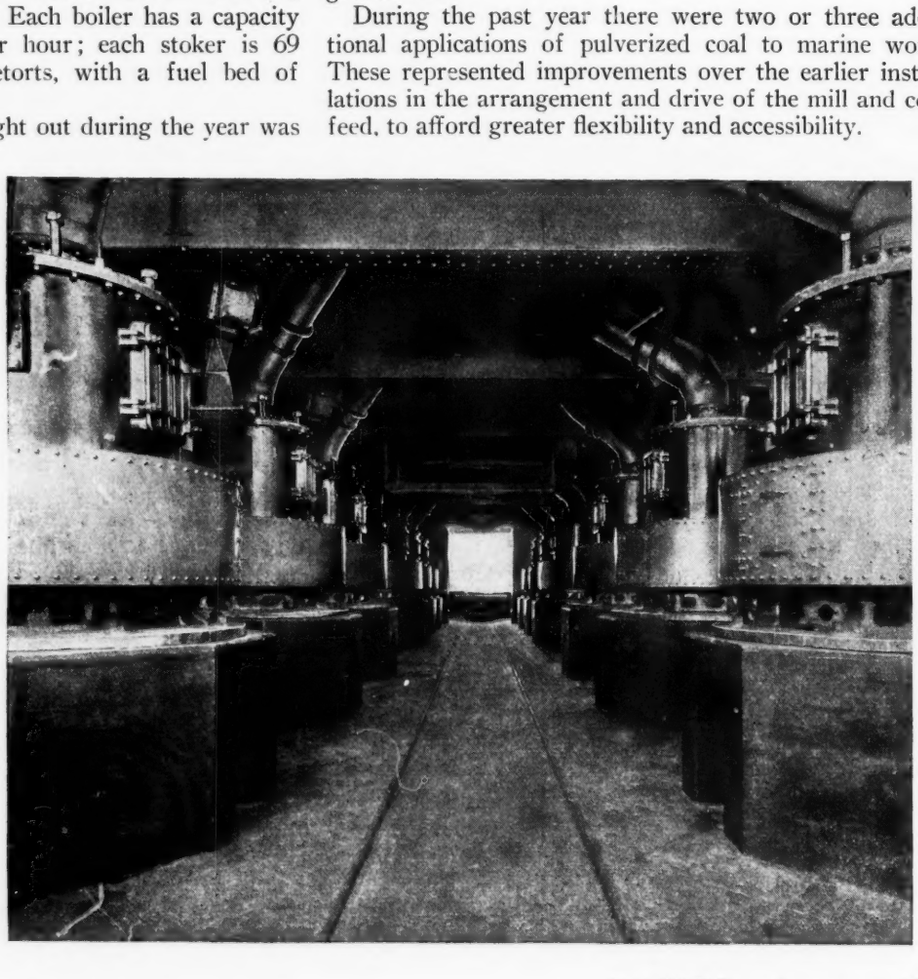
Pulverized coal definitely established itself several years ago. The past year has seen a continuation in the advance of the number of direct-fired pulverized-coal installations for both public utility and industrial plants. As is to be expected, engineers differ as to the relative merits of direct-fired and storage systems, but reports from plants indicate that the operating results are about on a parity, so apparently reasons other than efficiency have caused the increase in unit pulverizer installations.

In 1924 the public utility boiler capacity for which the central systems was applied was 9,000,000 lb. per hour, and 2,500,000 lb. with direct firing. In 1930, the total capacity of central system boilers was 4,500,000 lb. of steam, and of direct-fired boilers, 13,000,000 lb. During the year two new designs of vertical mills were introduced. In one the pulverizing elements consist of two disks carrying short hammers, separation being accomplished by air.

Although embodying the spherical ball and grinder ring principle of pulverizing used in the standard pulverizer made by its manufacturer, the second new design has two rows of balls instead of one, and one rotating and two stationary grinding rings.

An innovation in a number of plants is the placement of the feeder on the firing floor, which enables the operator to control the coal going to the pulverizers with greater ease.

During the past year there were two or three additional applications of pulverized coal to marine work. These represented improvements over the earlier installations in the arrangement and drive of the mill and coal feed, to afford greater flexibility and accessibility.



Twelve vertical coal pulverizers installed in the Riverbend plant of the Duke Power Company. This plant operates as a stand-by and is used only during periods of water shortage

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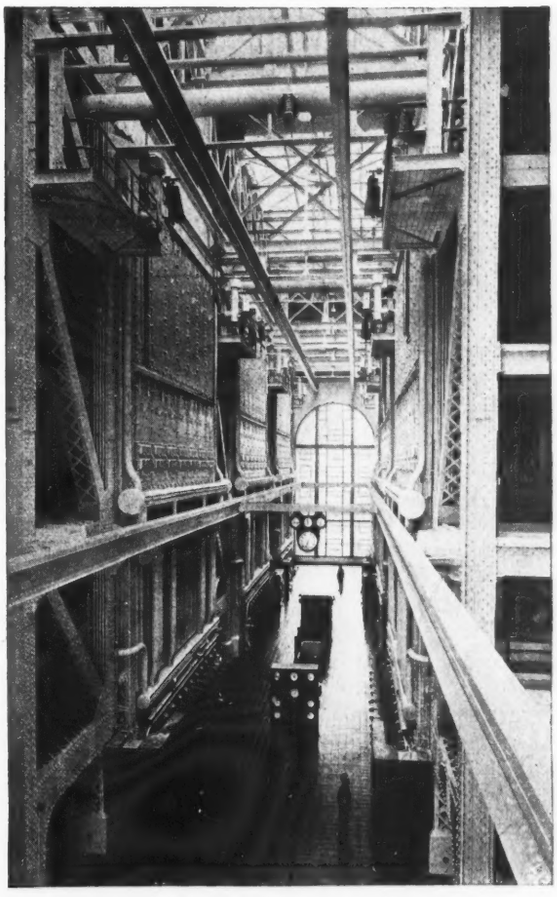
Boilers Trend Toward Large Units

Boiler units in two plants have produced over a million pounds of steam an hour, superheaters for steam temperatures over 800 deg. are being furnished, and nineteen slag-bottom furnaces have been installed during the past year



Six 34,162-sq.ft. cross-drum gas-fired boilers at the Long Beach station

MOST IMPORTANT to users and manufacturers have been the developments in welded boiler construction. Anticipating a revised A.S.M.E. Boiler Code that will permit fusion welding of boiler drums under proper safeguards, several manufacturers have installed extensive welding and testing equipment and have developed effective production techniques. These developments are covered in greater detail in the report on welding, pages 38 and 39. Being free from the limitation on boiler codes, the navy has approved the use of fusion welding in fabricating the drums of twenty-four boilers for new scout cruisers.

Outstanding in the field of large boilers are the installations at the Kips Bay plant of the New York Steam Corporation and the additions to Hell Gate station of the United Electric Light & Power Company. These boilers have produced individually more than a million pounds of steam per hour, though the 1,250,000 lb. per hour output of the East River boilers has not been exceeded.

Twice the Output in Same Floor Space

The new Kips Bay boiler, with a total heating surface of 42,380 sq.ft., occupies the same floor area as do each of the boilers originally installed in that plant in 1926, but its output is more than double. This greater capacity was secured by increasing the number of boiler tubes, lowering the furnace bottom (which made possible greater water-wall surface) and improvements in firing, as described in the Sept. 2, 1930, number of *Power*.

The two new units at Hell Gate each have a total heating surface of 52,306 sq.ft. Each comprises two cross-drum water-tube boilers set back to back over a single water-wall slag-tap furnace. So far as known, this is the first time cross-drum water-tube boilers have been placed in such a double setting. Nominal design output of the units is 800,000 lb. per hour, but coal-burning and fan equipment have been provided with capacity to handle a boiler output of a million pounds an hour.

What is believed to be the largest sectional header boiler unit is being built for the Duluth steam electric station of the Minnesota Power & Light Company. The boiler has forged steel sectional headers and contains 36,300 sq.ft. of heating surface, designed to deliver steam at 485 lb. pressure and 760 deg. temperature.

These installations indicate that the trend toward large boilers continued during 1930. Inquiries received by manufacturers promise still larger units. Negotiations are under way for a boiler of 1,500,000 lb. per hour capacity, and the practicability and price of a unit of 500 lb. pressure with a maximum capacity of 2,000,000 lb. an hour has been discussed.

Three high-pressure stations, Deepwater (N. J.), Gilbert and South Amboy, containing only high-pressure boilers, were placed in operation during the past year. Two of them have operated for sufficiently long time to have encountered boiler troubles. Both plants, however, report satisfactory boiler operation, the only trouble being leaks which were stopped by rerolling.

High-pressure boilers are under construction for five stations. Six boilers have been ordered to supply 1,200-lb. steam to two new turbines at the State Line

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plant. Four of these are standard boilers of 500,000 lb. per hour maximum capacity, the other two being reheat boilers of 351,000 lb. per hour capacity. For Concepcion Roads plant of the San Antonio Public Service Company one cross-drum boiler of 215,000 lb. per hour capacity supplying steam at 1,464 lb. pressure is being installed. Two 350,000-lb.-per-hour 1,450-lb. pressure boilers are on order for the Deepwater station of the Houston Light & Power Company. At these two latter plants the boilers are fired with natural gas and oil. Two 300,000-lb.-per-hour 1,390-lb. pressure boilers are being installed at Lakeside.

Purdue University has ordered a boiler to operate at over 3,200 lb. pressure, the first unit of this pressure in America. The installation of the 1,800-lb. boilers at the Philip Carey plant has been completed and is expected to be placed in operation early this year.

Several manufacturers have brought out new low-head boilers that are particularly suited for small industrial installations where headroom is important.

The new boilers for State Line, and Deepwater (Houston, Texas) are to have supreheaters designed to furnish steam at 825 deg. Excepting the experimental unit at Detroit, these units are the first in America designed for over 800 deg., and probably foreshadow general acceptance of higher temperatures.

Superheaters and Resuperheaters

The experimental superheater installation at the Trenton Channel plant of the Detroit Edison Company has been in operation for over a year, heating 700-deg. steam to final temperature of 1,100 deg. It is built of refractory-covered chrome-nickel steel tubes, which show no evidence of deterioration.

The present trend in superheater design is to locate the steam headers outside the boiler setting, thus removing them from the gas path. Efforts to improve distribution of steam to the superheater have resulted in replacing the saturated steam pipe by a number of tubes that connect the boiler steam drum with the superheater inlet header.

Resuperheaters have followed closely the improvements in superheater design. Attempts are being made to maintain the reheat temperature constant with variations in load. Combination gas and steam reheaters have been installed in several of the high-pressure stations to accomplish that end.

No radical changes in economizer construction are apparent, though some manufacturers report an increasing use of the steaming type. Economizers are being installed regardless of high feed-water temperature resulting from regenerative heating.

Water walls have become accepted practice with large utility boilers, particularly where high ratings are to be encountered. This should not be construed to mean that water walls are not suitable for industrial plants, for their use in that field is increasing..

During the past year a new armored water wall was brought out. It is built of blocks machined to fit about one-quarter of the tube circumference. They are pulled backward between the tubes by a toggle arrangement so that they press tightly against the tube and when in place present a flat surface to the furnace.

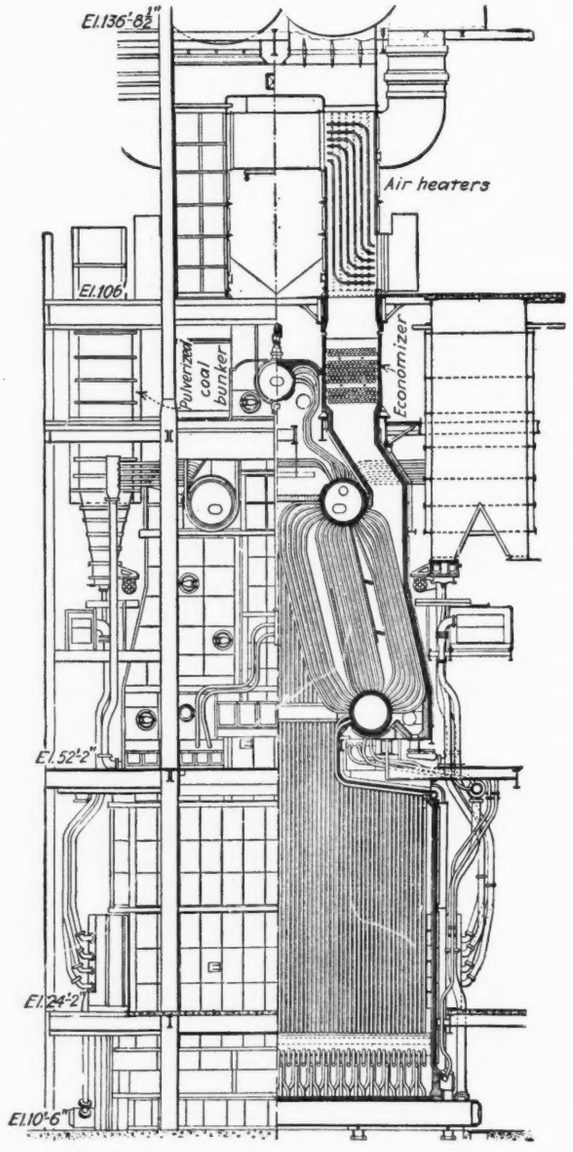
The slag-bottom furnace for pulverized-coal installations is becoming increasingly popular. There are 46 furnaces in operation with this type of ash removal, 19 are under construction and 4 are nearly ready to start up. There has been considerable variations in the performance of this type of furnace floor, and considerable research has been undertaken to find the best material out of which to construct it.

Dolomite, mica schist and carbon have been tried, but magnesite seems to be giving the best results. The most recent installation is at Hell Gate, where two furnaces are equipped with air-cooled slag-tap bottoms in which magnesite is used.

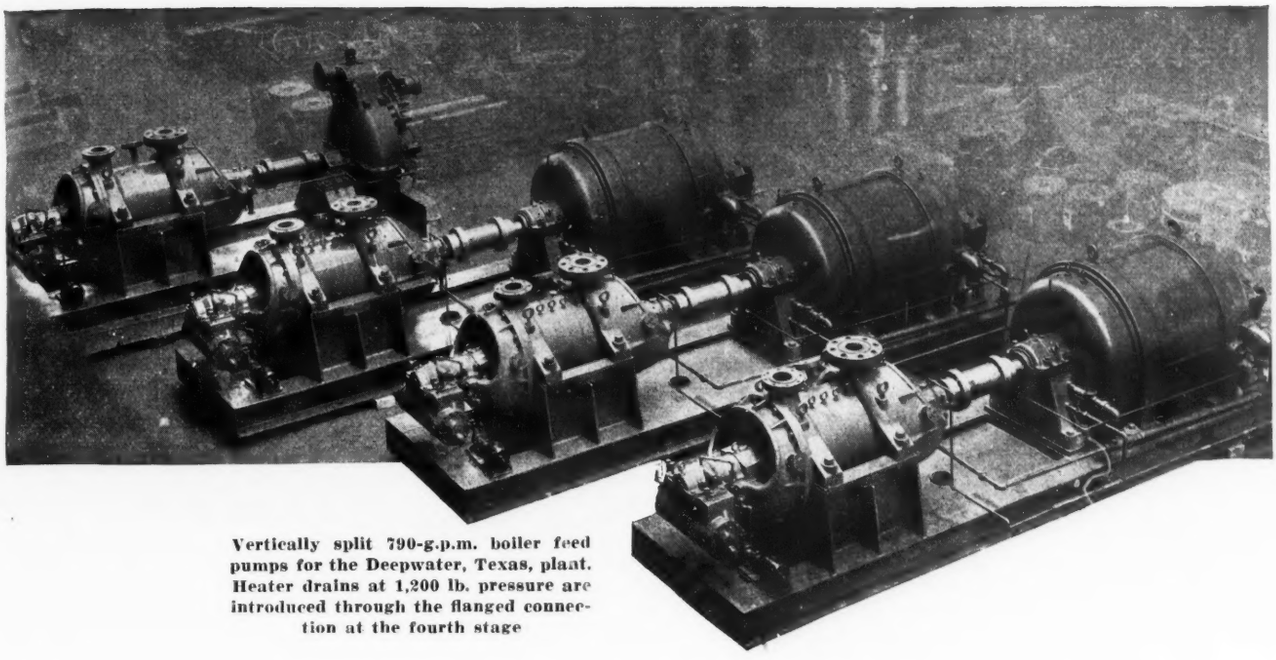
At State Line the slag-bottoms have been made the target for vertically fired pulverized coal. It is expected that with this arrangement the molten slag will catch a greater portion of the ash than is possible with horizontal firing, and so reduce the troubles from slag collecting on boiler tubes and from fly ash leaving the stack. Slag screens are provided just below the boiler tubes. A wider application of this method of firing is looked for.

Certain difficulties have been encountered owing to the expansion of the floor, so that the material to use for the furnace bottom and the construction that will permit expansion without endangering the furnace walls are the new problems that seem to be approaching solution.

In the field of refractories the most important development of the year was the formulation of scientific tests for determining their serviceability for boiler fur-



This new unit at Kips Bay steam plant has generated over a million pounds of steam an hour



Vertically split 790-g.p.m. boiler feed pumps for the Deepwater, Texas, plant. Heater drains at 1,200 lb. pressure are introduced through the flanged connection at the fourth stage

naces. These were announced at the annual meeting of the A.S.M.E. in New York City in December.

In one test a crucible is hollowed out of a piece of the refractory. In it is placed some of the slag to be tested with the given refractory. This is brought up to the furnace temperature and then quenched to fix the momentary state of the "solution." A study of the resulting samples has shown that the amount of undissolved refractory in the "glass" is a measure of the erosive action of the slag: That is, a slag fully saturated with refractory solids will be less apt to dissolve new refractories and cause erosion.

Another method announced involves the rotation of an experimental furnace lined with the brick to be tested and containing some of the slag to be tested with it, both maintained at the furnace temperature. It was claimed by some that while this latter test is less fundamental than the former, it may be more easy of application by unskilled operators.

There has been an increase in the handling of ash by water sluicing. Improvements to dewatering ash bins now make it possible to pump pulverized-fuel ash as well as stoker ash into a bin, taking the water out and leaving the ash in the bin. Ash pump design has been changed so that small clearances in the pump are clear-water sealed to reduce wear from the abrasive action of the ash. This makes possible continuous high efficiencies against high heads.

Turbine Drives for Fans

Turbine drives for induced- and forced-draft fans are finding increased favor. A recent outstanding installation is that of the United Electric Light & Power Company at Hell Gate. The induced- and forced-draft fans for the two boilers recently installed are driven by cross-compound turbines. The high-pressure element of the turbine drives two induced-draft fans through reduction gearing. The low-pressure element drives a forced-draft fan. Two such sets serve one boiler. This arrangement makes it impossible to shut down the induced-draft fan without shutting down the forced-draft unit. Regulation of the set is by combustion-control equipment.

In high-pressure plants, air for soot blowing is being used increasingly, because of the difficulty of reducing the steam pressure for use in soot blowers. A soot blower particularly designed to employ air has been made available.

In the field of high-pressure boiler-feed pumps the vertically split centrifugal with solid diaphragms to prevent internal leakage is an outstanding development. Pumps of this type to deliver 200,000 to 900,000 lb. of water per hour at pressures of 1,300 to 1,600 lb. have been installed. About 25 units were ordered during the past year.

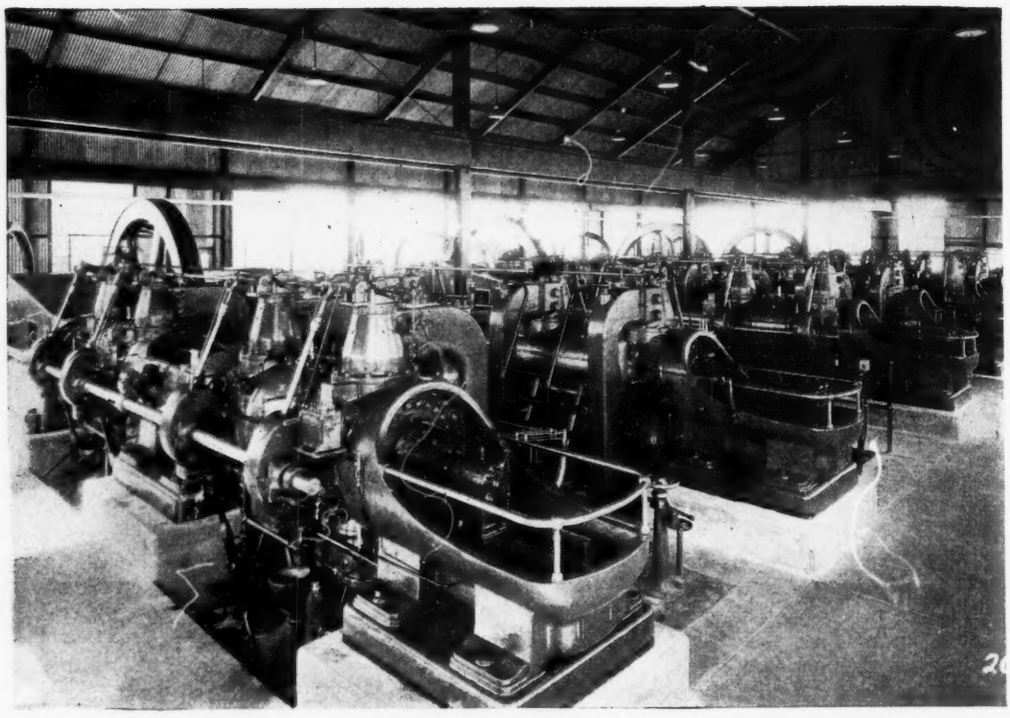
Feed-Water Problems Increase

Perhaps the most interesting trend was the increased attention given by central station operators to the chemical side of the boiler-water problem. Many have found it desirable to pretreat water fed to the evaporators. For this purpose both the lime-soda process and the zeolite were used. Zeolite pretreatment practically eliminated evaporator scaling, but left the problem of evaporator blowdown and carryover through priming. Continuous blowdown of boilers, with heat recovery, made substantial gain during 1930.

One of the new high-pressure stations has been experiencing difficulty with the deposit of silica scale upon the blades of high-pressure turbines. The apparent cause is the carryover of silica in the entrained moisture of make-up evaporators, and the dissolving of this silica in the high-temperature boiler water. In one case at least the difficulty was corrected by the installation of a steam separator at the evaporator outlet.

The more general adoption of higher pressure led, indirectly, to greater use of various phosphates in the conditioning of boiler water.

Some of the central heating plants operating boilers at very high ratings, with almost 100 per cent make-up, have had to give special attention to the problem of phosphate feed, and have developed methods of boiler-water control that should be of great interest to industrial plants. One large central heating company reported that to avoid deposits in economizers and feed lines it is feeding phosphate directly to the boiler in proportion to the boiler output.



Natural-gas pumping plant driven by tandem double-acting gas engines installed during the past year

Gas and Oil Engine Developments

Important advances include a greater acceptance of airless injection, high-speed engines and more metropolitan installations

DESPITE the general business depression, several factors have combined to maintain the 1930 output of the diesel engine manufacturers to within 10 per cent of the record of 1929. The gas engine industry has enjoyed the best year of its existence, although this cannot be said of all the individual factories; for while some factories have been filled up with orders for gas-line pumping engines, others that have centralized upon the production of smaller engines for oil field work have been less fortunate.

The gas engine was improved but slightly during the year. Roller bearings for layshafts and, in one instance for crankpin and main journals, were employed. Pressure lubrication has more or less definitely replaced oil cups or oil cellar lubrication of bearings, to permit higher piston speeds on single- and two-cylinder engines. Many gas recompression units were installed in the Southwest, but vertical high-speed engines were not so favored for oil-well operation as in former years.

Many gasoline engines were installed for stand-by service in water-works and in a few cases in office buildings and industrial plants.

The situation as regards the use of gas in diesel cylinders has shown some advancement; one user is preparing to change to gas on a number of large diesel engines. On the other hand, several oil engines were installed to burn gas on the low-pressure Otto cycle, with magneto ignition.

While it cannot be said that any radically new engine design, either gas or diesel, has appeared during the year, certain tendencies observed in former years have become fairly crystallized into accepted practices during 1930. Among these is the almost universal adoption of airless, or solid, injection by American oil engine builders.

One of the events that was received with intense interest by all interested in oil engines was the adoption of the A.E.G.-Hesselman solid injection for large engines by the oldest builder of air-injection engines in the country. The public announcement of this was followed by the sale of a 3,000-hp. unit to the city of Freeport, N. Y., where 4,300 hp. of air-injection engines is in service, and a 4,000-hp. engine to the Tucson Gas & Electric Company, Tucson, Ariz., where 12,000 hp. of air-injection units is installed.

Other engine builders have adhered to air-injection for slow speeds, but have turned to the solid-injection principle for high-speed units.

During the last few years the horsepower of solid-injection engines installed per year has surpassed that of air-injection, and the rates will be substantially increased in the future. This has resulted from decided improvements in spray valve and pump designs, to permit this type to burn as low grade oils as are handled successfully by air-injection engines.

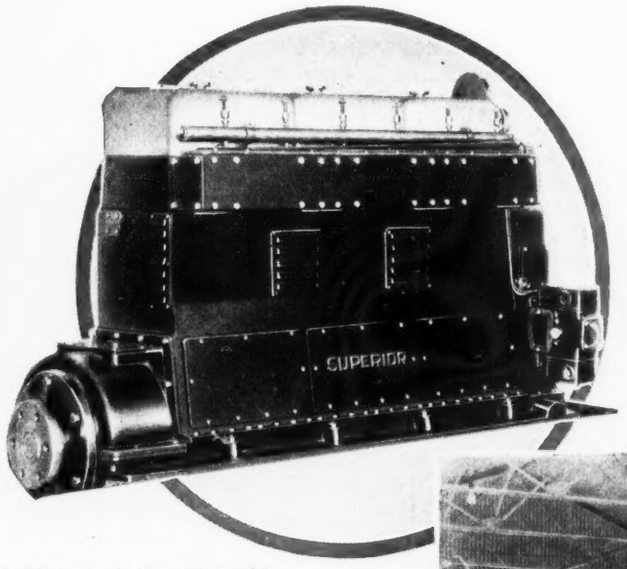
A second design tendency is the more general adoption of direct injection into the engine cylinder of solid-injection units.

From 1924 to 1929 engines employing precombustion ignition chambers predominated, but in 1930 this lead was destroyed as the prominent precombustion engine manufacturers turned to direct injection. In most instances this has permitted an increase in mean effective pressure to around 58 lb., so that the engine is not so seriously handicapped as to cylinder volumes.

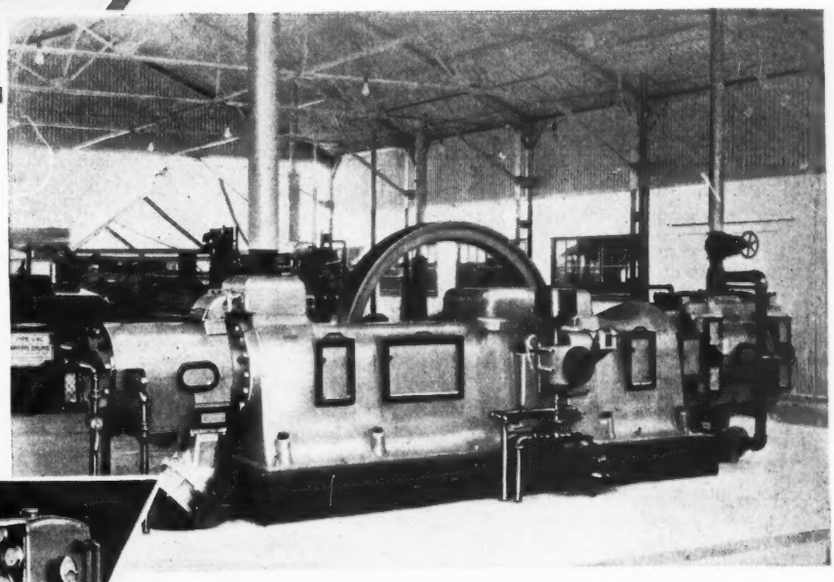
The third design trend is in the matter of speed. While certain manufacturers have produced high-speed diesels for certain special applications, such as rail cars, locomotives and shovels, there is a general acknowledgement of the drift toward higher speeds in all reciprocating speeds. Consequently, several firms have evolved high-speed engines to meet ordinary power requirements.

Two well-known firms introduced high-speed designs during the year, one a 300-hp., 6-cylinder, 750-r.p.m. engine for locomotive application, and the second engine of similar capacity for general service. Several other firms have high-speed units on their test floors. These designs incorporate the use of nickel steel and nickle cast iron in the frames and lining, aluminum pistons and special alloy-steel valves and shafts.

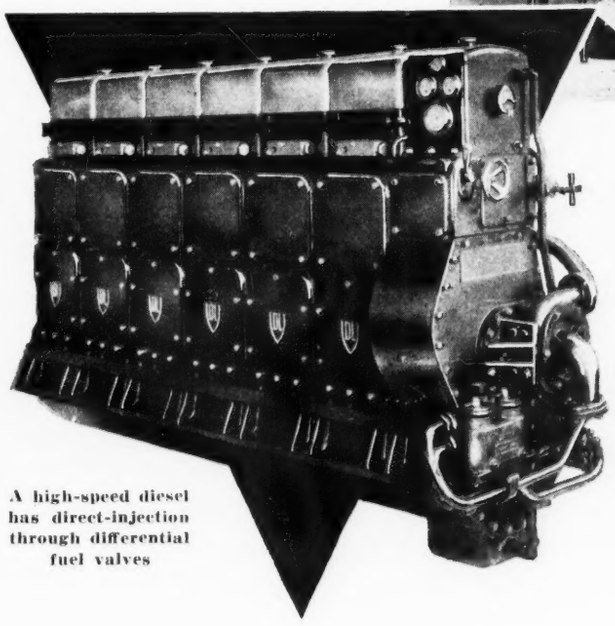
It is too early to predict universal adoption of higher speeds. When production is attained costs per horsepower must be reduced, as the chief inducement for the installation of a high-speed engine for general power purposes is, inherently, its lower cost.



A high-speed diesel brought out in 1930 with a common-rail fuel system



A double-acting gas-engine and compressor unit designed to meet demand for medium-capacity machines



A high-speed diesel has direct-injection through differential fuel valves

In spite of the hundreds of diesel trucks and buses in Europe, the light-weight engine has not been commercially developed in this country, although two companies have built small units applicable to buses and trucks. The lag in light-weight engine development is due primarily to the absence of the urge of excessive fuel costs. Gasoline is cheaper than it has been for years, and when purchased on the tank car basis is not so markedly higher in price than is a high-grade fuel oil of the character suitable for light-weight engines. However, with the increase in truck capacity and extension of hauling distances, the fuel cost probably will force the use of engines capable of burning a heavy fuel.

During the year the fields of diesel application have

not increased. As in former years, central stations absorbed the largest allocated percentage, with marine application next. The steadiness in central station installation is traceable largely to the municipal situation in the mid-west. Many franchises have expired in the last few years and muncipalities instead of renewing the franchises have installed their own lighting systems or have increased the existing capacity, frequently on the lease or savings plans.

This movement has received an impetus in states where it has been judicially declared that municipalities may build light plants on the lease or payment plan.

Among the municipalities installing diesels during the year were Freeport, N. Y.; Rockville Centre, N. Y.; Roslyn, N. J.; Sikeston, Mo.; Higgensville, Mo.; and South Norwalk, Conn.

Privately owned utilities have installed a number of diesels, including a 2,400-hp. unit at Pecos, Texas, by the Louisiana-Texas Power Company, and a 4,000-hp. unit by the Commerce Royalty & Mining Company, Cardigan, Okla. This latter corporation is primarily engaged in mining, but supplies energy to a railroad and to the city of Miami, Okla.

Other large engines put into service during the year included several two-stroke-cycle units for the Phelps-Dodge interests and three for stand-by service in hydro-electric systems.

Construction of oil pipe lines was not active, but the orders for 60 engines for two gasoline pipe lines indicate a new departure in pipe line work and a potential outlet for many engines.

General industries have installed oil engines when the economics of the situation indicated.

The most important movement during the year was the installation of diesels in a number of offices and hotel buildings. Among these was one where the operation is entirely automatic, engines starting and stopping at change of load, without the presence of an operator. There is reason to believe that the economies obtainable will permit an enlargement of this field of application.

One outstanding installation was three 360-hp. diesels placed in the power plant of a West Virginia coal mine when the use-factor make a coal-burning plant less efficient.

Installations of large marine engines have been absent in American shipping, although foreign shipbuilders have produced more diesel than steam tonnage. The marked contrast in the two attitudes is due in part to the difference in price between diesel fuel and boiler oil along the Atlantic seaboard, and in part to the much lower cost of construction abroad.

A vital necessity is the adaptation of diesels to burn cheap bunker oil. The work being done by the Diesel Oil Standardization Committee of the A.S.M.E. should go far to remedy this situation and enable engine operators to purchase a cheap oil.

High-pressure cracking processes have eliminated much of the residual fuel oils, save among the small independent refiners in the Mid-West. In its place diesel owners are being offered re-run cracking distillates, whose chemical or physical constitution are so non-uniform or unstable that successful combustion in any but slow-speed engines cannot be guaranteed. This has prompted engine builders to write stringent specifications, to meet which the refiner must charge an excessive price for the fuel.

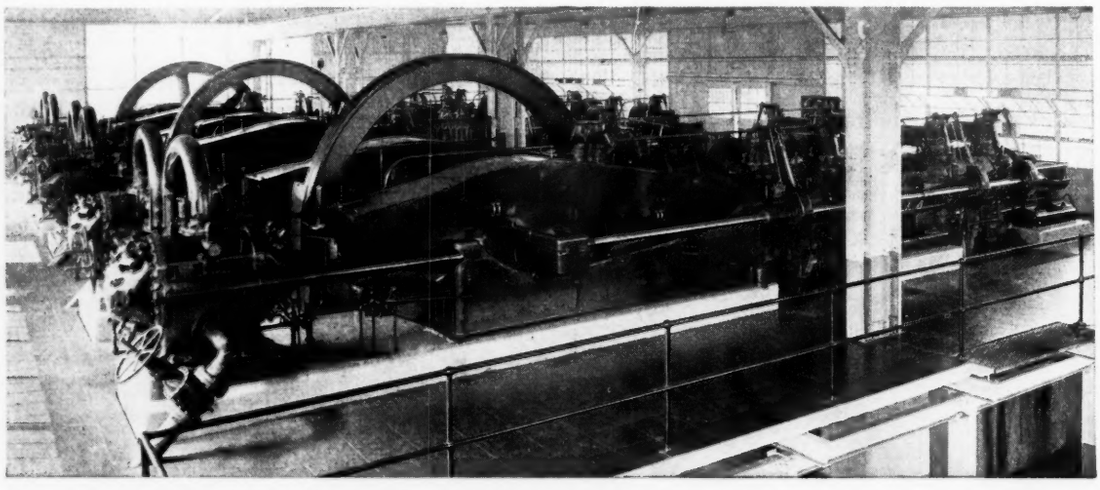
The initial work of the committee during the year was the determination of the undesirable oil characteristics, and during 1931 tests will be run to study the influence of viscosity and of carbon residue, followed by an investigation of ignition points.

Diesel Power Costs Collected

A second committee activity which has been productive of much interesting information is that on Diesel Power Costs, which has been carried on for two years under the auspices of the Oil and Gas Power Division of the American Society of Mechanical Engineers. In 1930 over 40 plants submitted detailed operating costs. While there were apparently marked inconsistencies in the reports, analysis revealed that when plotted against capacity factor the fuel oil consumption, the lubricating oil consumption and the total cost per unit output showed a marked uniformity for all the plants. This permits an engineer to make a close approximation of actual operating costs if the prospective plant's load curve is known or can be estimated. This work will be continued.

A number of oil engined river tugs were built during the year, as well as several ferry boats and yachts.

Among the foreign marine diesel installations of the year was the S.S. Britannic, which made its maiden trip in May propelled by two 10,000 hp. double-acting four-cycle units. The motorship LaFayette, powered with two-stroke-cycle engines, also made its first trip in May, 1930.



Gas-engine-driven pumping plant installed in 1930 for handling gas from wells in Texas and delivered to town in Kansas

Saluda plant of the Lexington Water Power Company in South Carolina

1,000,000 HP. of HYDRO Goes Into Service

and with 2,000,000 hp. under construction, 1930 closes as a banner year in water-power development

NOTWITHSTANDING the business situation, an unprecedented drought and the political complications that always haunt water-power development, 1930 was a banner year in hydro-electric construction. Over 1,000,000 hp. was put into operation, and the waterwheel manufacturers have contracts for over 1,200,000 hp. for projects in the United States. One manufacturer reports contracts for nine 84,000-hp. units to be installed in the Dneiper River plant in Russia. These contracts represent a total capacity of 756,000 hp. Therefore the waterwheel manufacturers have on hand contracts totalling about 2,000,000 hp. in various stages of construction. The capacity under construction shows an increase of about 500,000 hp. over that on the manufacturers' books at the beginning of the year. When it is considered that over 1,000,000 hp. was put into service, 1930 stands out as a milestone in water-power development. At the beginning of the year about 400,000 hp. was on contract for export, but this figure has increased to nearly 800,000 hp., of which 336,000 hp. is a carryover from last year.

Developments have been started or are being actively considered that will insure future large contracts for water-power machinery. During the year preliminary work was initiated at Boulder Canyon on the Colorado River. This project involves a dam 727 ft. high and the installation of about 1,000,000 hp., the largest project of its kind ever attempted in the United States. In addition to the water-power development, the city of Los Angeles plans to build a water system to take 1,000,000,000 gal. per day from the Colorado River. This water will be pumped against a head of about 1,523 ft. and will require 400,000 hp. of pumping equipment and 70,000 hp. of waterwheel capacity. Power for driving the pumping plants is to be supplied from the Boulder Canyon plant.

The State of Arizona is endeavoring to prevent construction of the Boulder Canyon project. Permission to bring suit in the United States Supreme Court is still pending, but in the meantime work on the project is being actively pushed. On Dec. 18 Secretary Wilbur made public the specifications approved by him for the project. Bids will be opened March 4 and the first power is to be generated in 1935.

During the past twelve months the country experienced the most severe drought on record and this is reflected in the percentage of power generated from water. Of the 96 billion kilowatt-hours produced in public utility plants last year only about 33.25 billions, or 34.7 per cent, was generated in hydro-electric stations.

The high mark for hydro-electric generation was reached in 1928, which was a wet year, when over 40 per cent of the total power generated in public utility plants was produced by water. This was followed by a dry year in 1929, and although the total kilowatt-hours from water-power plants was about the same as in 1928, the per cent of the total from public utility plants fell to about 37 per cent. This is slightly above the average for the ten years 1920 to 1929 inclusive.

National Hydraulic Laboratory Authorized

Model testing of parts and of whole hydro projects is increasing rapidly. New laboratories are being constructed and the facilities of others are being extended. Congress has approved a national hydraulic laboratory and appropriated $350,000 for its construction. This laboratory is to be under the supervision of the United States Bureau of Standards, Washington, D. C.

In order to obtain the necessary test data regarding runner elevation and other features in its new plant, the Safe Harbor Water Power Corporation constructed, at Holtwood, on the Susquehanna River, a hydraulic laboratory in which models of the turbines to be furnished are being tested under actual head conditions. Similar experiments have been carried out in the laboratory constructed by the Shawinigan Water & Power Company, Shawinigan Falls, Que. These cavitation experiments represent a distinct advance in hydro-electric engineering in this country. It is expected they will result in the use of propeller-type turbines more extensively and under higher heads than heretofore.

Two of the largest projects in this country to use propeller-type wheels were started last year and contracts let for the equipment. One, the Safe Harbor development of the Safe Harbor Water Power Corporation, on the Susquehanna River, in Pennsylvania, will have an initial installation of six 42,500-hp. units to operate under a 55-ft. head. The runners will be of the Kaplan type, having their blades adjusted automatically from the governor as the load changes. They are the largest of their type so far used in America, being 220 in. in diameter, and will discharge 8,000 sec.-ft. at rated power and speed. Space will be provided for twelve units in this plant, or a total capacity of 510,000 hp. Contracts for the first six units went to two manufacturing companies and a third company obtained the contract for the 38 steel gates to go on the dam.

A fourth company obtained the contract for the propeller-type wheels to be installed in the Rock Island plant of the Washington Electric Company. There are four vertical-shaft units rated at 21,000 hp. to operate at 100 r.p.m. under 32-ft. head.

The two largest-capacity units of the Francis type for installation in this country were ordered for the Diablo plant of the city of Seattle, Wash. They are rated at 90,700 hp. under a normal head of 327 ft. and will operate at 171.5 r.p.m. They will be installed in cast-steel scroll cases and on concrete elbow draft tubes.

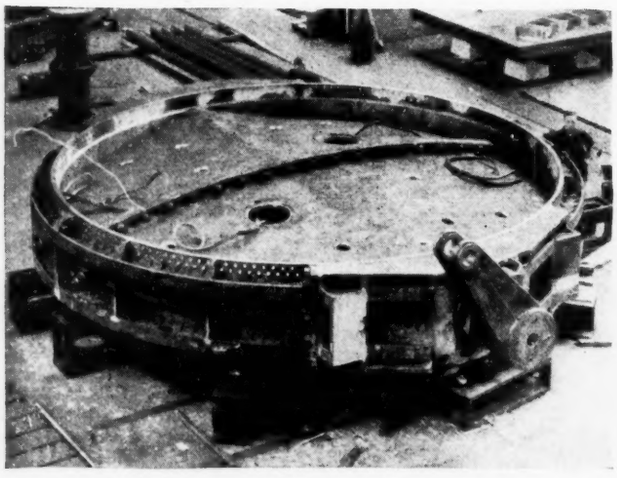
One of the largest single developments under construction using Francis turbines is the Osage project of the Union Light & Power Company, at Bagnell, Mo. Six 33,500-hp. units are being installed to operate at 112½ r.p.m. under a 90-ft. head.

Second High-Head Turbine Put in Service

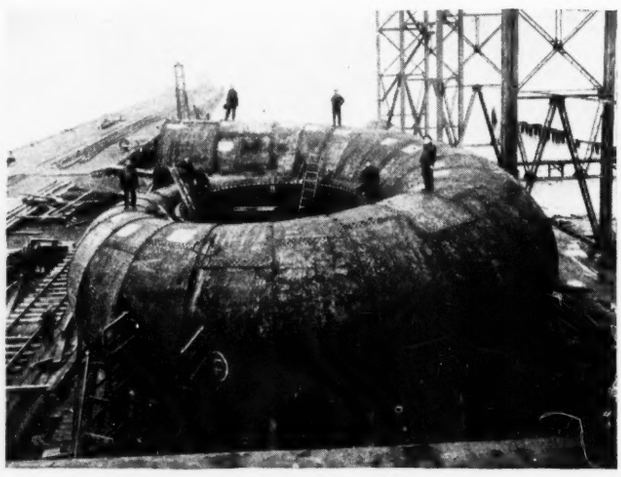
At the Oak Grove plant of the Pacific Northwest Public Service Company a second 40,000-hp. Francis unit was put into operation near the end of the year. The operating head on this plant is 860 ft. and the static 930, which makes it the highest head under which Francis runners are used in this country. This head for Francis-type runners has been exceeded by two installations in Europe.

Five additional units for the Dneiper River plant in Russia were ordered in this country last year. This makes a total of nine units under construction for that development and all are being built by one company. These turbines are rated at 84,000 hp. at their maximum efficiency when operating at 88.2 r.p.m. and under a 116.5-ft. head. Each unit will develop over 100,000 hp. at full gate when operating under the head of 123 feet.

Redevelopment and reconstruction of old water powers is quite active. One of the outstanding projects of



Butterfly valve 19 ft. in diameter for 123-ft. head in Ruskin plant, British Columbia



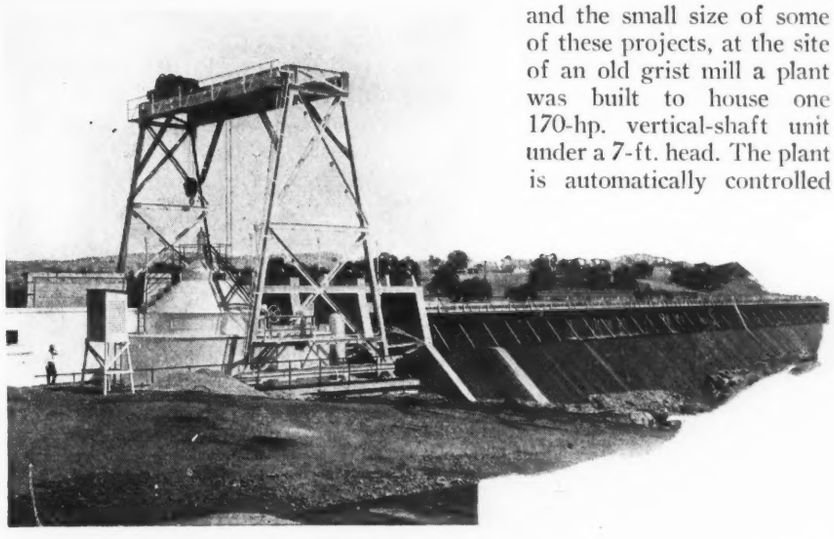
Spiral casing for one of nine 84,000-hp., 116.5-ft.-head waterwheels for Russia

Fifteen Mile Falls plant of the New England Power Association on the Connecticut River in New Hampshire and Vermont

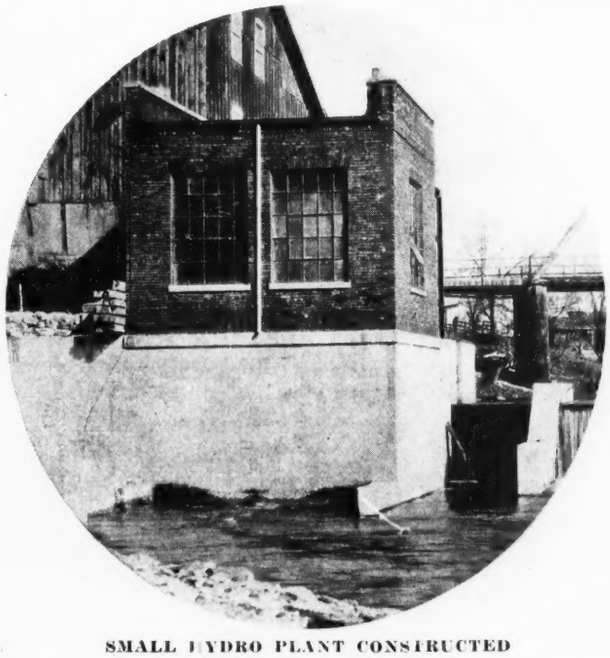
this kind is that at the Spier Falls plant of the New York Power & Light Corporation. When this plant was first planned it was laid out for ten 5,000-hp. horizontal-shaft units. Five of the units were installed. Some years later a 9,000-hp. vertical-shaft machine was added. This year a 57,000-hp. unit was installed to operate under an 81-ft. head.

In the plant of the Ozark Power Company, Ozark, Mo., horizontal-shaft inefficient units of antiquated design were replaced by four vertical-shaft machines having a total capacity of 30,000 hp. Not only is the efficiency of the plant increased, but a substantial increase in power is obtained.

Redevelopments cover a wide range of capacities and conditions. Many of them are in industrial plants where it is found that the old water-power equipment is inadequate for present requirements. In other cases sites that were once occupied by industrial plants are being redeveloped by public utility companies with the installation of modern equipment. As an illustration of this and the small size of some of these projects, at the site of an old grist mill a plant was built to house one 170-hp. vertical-shaft unit under a 7-ft. head. The plant is automatically controlled



Outdoor hydro plant of the San Joaquin Light & Power Corporation at Merced Falls, Calif.



SMALL HYDRO PLANT CONSTRUCTED AT SITE OF AN OLD GRISTMILL

This plant contains a 170-hp. vertical shaft unit of modern design to operate under a 7-ft. head and is a good example of how small water powers may be developed.

IMPORTANT HYDRO-ELECTRIC PROJECTS PUT INTO OPERATION OR UNDER CONSTRUCTION IN 1930

Company	Project	No. of Units,	Size, Hp.	Head, Ft.	Type
Put Into Service					
New England Power Assn.	15 Mile Falls	4	53,100	175	Francis
Lexington W.-P. Co.	Saluda	4	55,650	180	Francis
Arkansas Pw. & Lt. Co.	Carpenter	2	39,500	89	Francis
Pacific N. W. Public Service Co.	Oak Grove	1	40,000	860	Francis
City of Tacoma	Cushman No. 2	2	37,500	440	Francis
Montana Power Co.	Morony	2	31,000	82½	Francis
N. Y. Pr. & Lt. Corp.	Spier Falls	1	57,000	81	Francis
N. Y. Pr. & Lt. Corp.	Conklingville	2	17,150	71	Francis
Conn. River Dev. Co.	McIndoes Falls	2	5,120	29	Kaplan
San Joaquin Lt. & Pr. Co.	Merced Falls	1	4,750	26	Kaplan
Knoxville Pr. Co.	Caldewood	2	56,000	213	Francis
Turners Falls Pr. Co.	Cobble Mt.	2	19,200	420	Francis
Turners Falls Pr. Co.	Cobble Mt.	1	8,550	420	Francis
Alabama Pr. Co.	Lower Tallassee	2	36,000	88	Francis
Carolina Pr. & Lt. Co.	Waterville	1	49,000	850	Francis
Under Construction					
Safe Harbor W.P.Corp	Safe Harbor	6	42,500	55	Kaplan
New Kanawha Pr. Co.	Hawk's Nest	4	35,000	158	Francis
Consumers Pr. Co.	Hardy Dam	3	14,900	99	Francis
Union El. Lt. & Pr. Co.	Osage	6	33,500	90	Francis
Union El. Lt. & Pr. Co.	Osage	2	3,025	90	Francis
Washington El. Co.	Rock Island	4	21,000	32	Propeller
Washington El. Co.	Rock Island	1	2,100	32	Propeller
Central Main Pr. Co.	Wyman	2	34,000	135	Francis
Pacific Gas & El. Co.	Tiger Creek	2	36,000	1,190	Pelton
Pacific Gas & El. Co.	Sale Springs	1	13,500	244	Francis
City of Seattle	Diablo	2	90,700	327	Francis
Inland Pr. & Lt. Co.	Ariel	1	50,000	170	Francis
Foreign Contracts					
Russia	Dneiper River	9	84,000	116.5	Francis
Agricola de Fuerza	Rosetilla	1	14,000	78	Francis

from another installation approximately five miles away.

The design of these small plants is being given increasing attention, and some of the waterwheel manufacturers have developed modern self-contained units particularly adapted to this class of installation. A new type of unit for low-head developments utilizes a concrete spiral casing and a telescopic pit ring. This design allows the turbine casing to be tied rigidly into the power house concrete structure and provides flexibility between the turbine and the setting. In this design simple, substantial parts, with comparatively light weight to be carried by the power house foundation, of the open-flume design, are combined with the rigidity, stability and accessibility of the more expensive concrete spiral-casing type.

More Outdoor Hydro Stations

The outdoor type of plant continues to gain in favor. Two such installations went into operation during the year just passed. One is on the Merced River in California on the San Joaquin Light & Power Corporation's system. This project is a redevelopment of an old plant. The old dam was reinforced and its height raised 7 ft., increasing the head from 20 to 27 ft. This change and the additional water available from irrigation allowed increasing the capacity of the installation seven times.

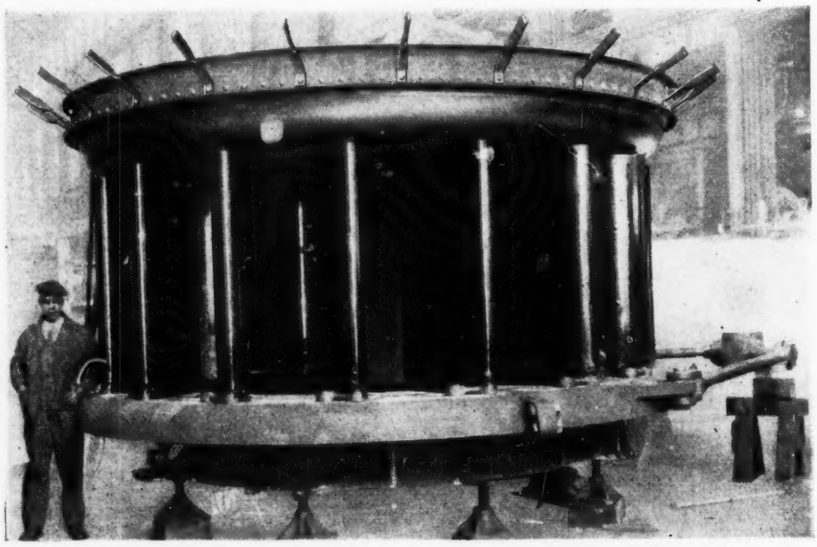
The Moroney plant of the Montana Power Company is also of the outdoor type. It contains two 31,000-hp. machines and went into operation recently.

Some notable butterfly valves were put into operation during the past year. At the Pigeon River plant of the Carolina Power & Light Company three valves of this type, 9 ft. in diameter, are operating under 836 ft. head. The valves are made of cast steel and are arranged for switchboard control. At the Calderwood plant of the Knoxville Power Company in Tennessee there are two 16-ft. butterfly valves operating under 213 ft. head. In British Columbia, at the Ruskin plant of the Western Power Company butterfly valves 19 ft. in diameter are being used under 123 ft. head.

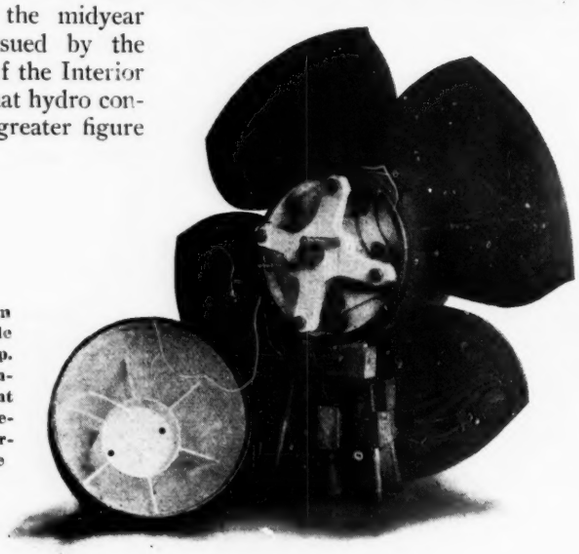
In Canada water-power developments are going ahead at an unprecedented rate. In the midyear water-power review issued by the Dominion Department of the Interior the opinion was given that hydro construction amounts to a greater figure than at any previous period in the history of the Dominion. Installations aggregating more than 1,680,000 hp. are under active development from coast to coast. Many of the installations comprise the initial stages only, and when they are built to their ultimate capacity another 2,000,000 hp. will be added.

The foregoing opinion is borne out in the contracts placed for water-power equipment. One manufacturer reports putting in operation during 1930 over 214,000 hp., and has 750,000 hp. capacity under construction. The Beauharnois project on the St. Lawrence River is the most gigantic in Canada. The initial development is designed for 500,000 hp., but the project is laid out for 2,000,000 hp. Contracts have been placed for four of the ten 53,000-hp. units to be installed in the first section of the power house. Two 8,000-hp. house units have also been ordered. The wheels will operate under 83 ft. head and are therefore of very large dimensions. Another large contract that was placed recently includes five 60,000-hp. waterwheels to be installed in the Abitibi Canyon development of the Ontario Power and Service Corporation, in Northern Ontario.

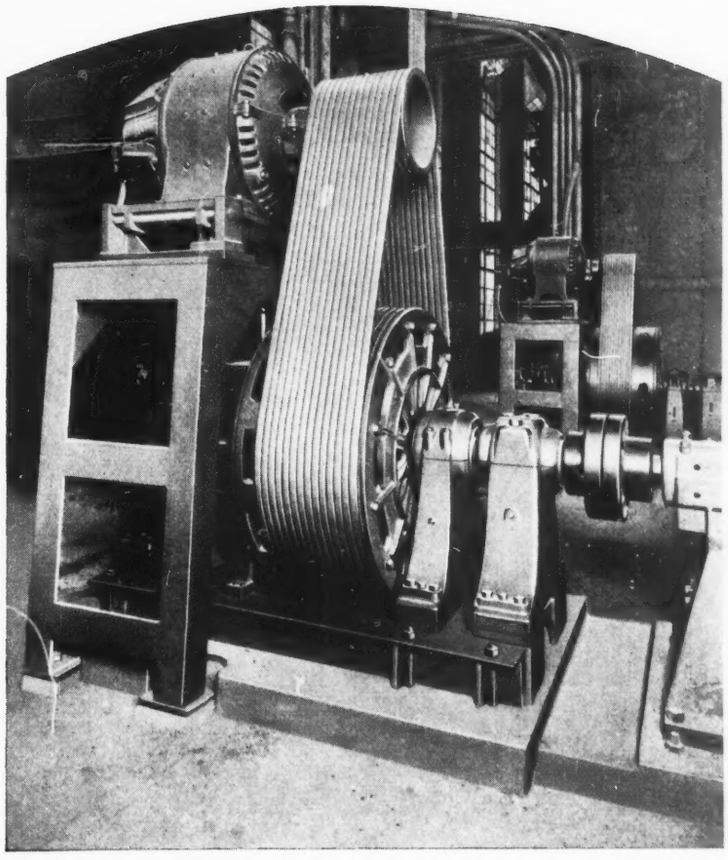
At Chats Falls on the Ottawa River eight 28,000-hp. units are being installed in the plant of the Ottawa Valley Power Company. Work is nearing completion on the plant of the Alcoa Power Company, where four 65,000-hp. units are installed. Rapid progress is being made on the plant of the Northwestern Power Company at Seven Sisters Falls on the Winnipeg River, where three 37,500-hp. propeller-type wheels with fixed blades are being installed. These wheels will operate under 66 ft. head. The foregoing is typical of what is taking place in water-power development in Canada. About 98 per cent of the power produced in central stations in the Dominion is generated by water power, consequently it has become the backbone of our northern neighbor's industrial development.



Turbine casing assembled with telescopic pit ring for grouting into the power house floor



One of two Smith-Kaplan turbines with adjustable blades rated at 5,120 hp. under a 290-ft. head installed in the McIndoes plant of the Connecticut River Development Company, in Vermont and New Hampshire



Rossman adjustable-speed drive operating on induced draft in Powerton station

Turbine-driven 200,000-kva. generators to operate at 1,800 r.p.m. The first hydrogen-cooled generator goes into operation. Field for outdoor type of machines widened. Mercury-arc rectifier applications increase rapidly

Electrical Field Records Notable Progress

IN 1930 the electrical output of central stations was 95.8 billion kilowatt-hours, which was less than a billion under that of 1929. This represents a decrease of 1.6 per cent compared with a yearly gain of about 9 per cent for several years previous.

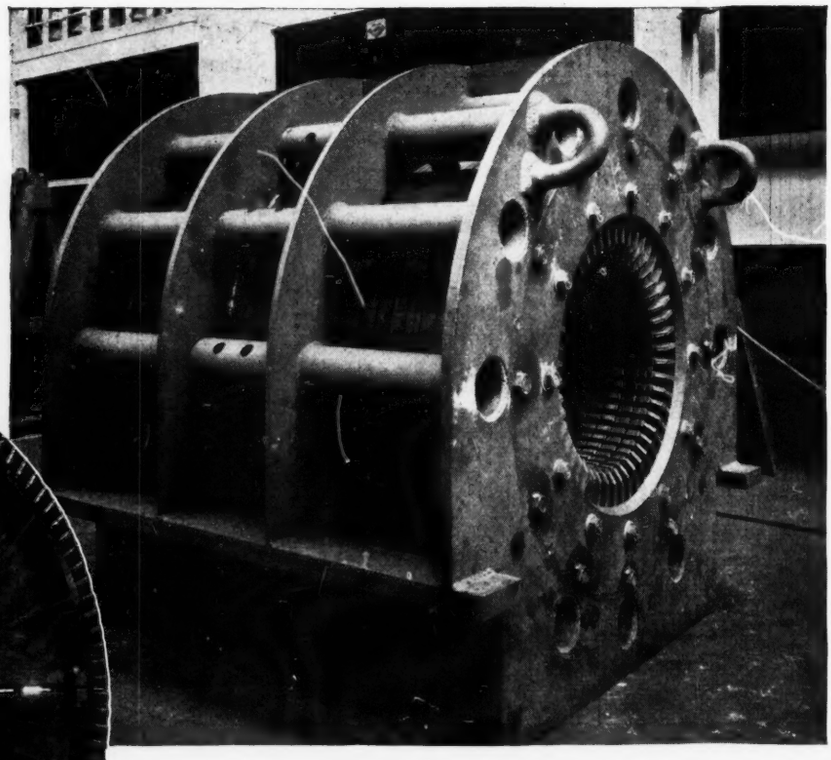
In the equipment field, conditions were more favorable than might have been expected. On account of the great diversity of the products produced, the electrical manufacturing industry felt the depression less than many others. There was a decline over previous years in requirements for certain classes of electrical apparatus, but for other equipment there was an increase. To meet present competition, manufacturing industries are modifying their old plants by electrifying them, and those that are electrified are extending the applications by adopting new devices and improved methods.

Although the record size of generating units of 1929 remained unbroken in 1930, there were several large machines ordered. Among these are two 200,000-kva. 0.80 power factor generators for the Brooklyn Edison Company. These machines are similar to the unit installed in the East River station of the New York Edison Company, except that the Brooklyn generators will operate at 1,800 r.p.m. instead of 1,500 r.p.m. as does the older unit. These machines are the largest 1,800-r.p.m. units so far attempted and are being designed for 16,500 volts.

At the Chicago District Electric Generating Company's plant two 22,000-volt 1,800-r.p.m. generators are being installed, one being rated at 175,000 kva. and the other at 125,000 kva. Although the foregoing machines represent the largest contracted for during the past year, several in the 75,000- and 100,000-kva. class have been installed or are under construction. In the large machines, as evident from those previously mentioned, the tendency is toward voltages above the conventional 13,200. So far 22,000 is the highest used in this country, but in Europe generators have been built for as high as 33,000 volts.

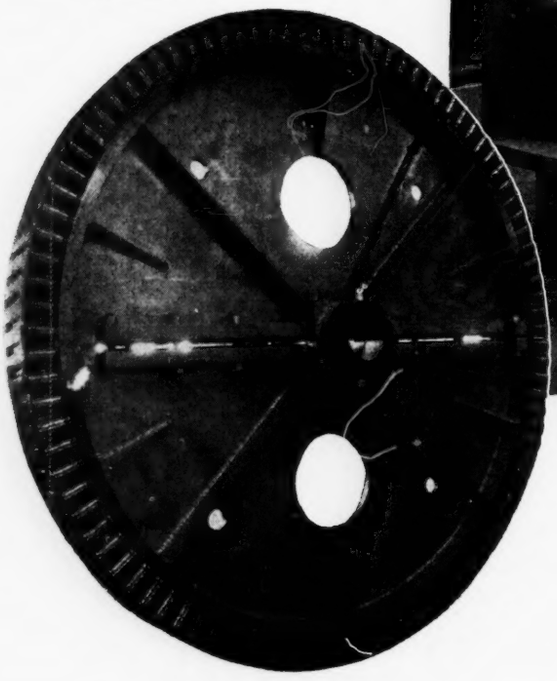
Like steam-turbine-driven generators, waterwheel generators trend toward large-sized units. In the Spier Falls plant of the New York Power & Light Corporation a 47,000-kw. vertical-shaft unit was put into operation. On account of its slow speed, 81.8 r.p.m., this generator's dimensions are unusually large, it being 43 ft. in diameter. A combination thrust and guide bearing is used and is located on the shaft below the rotor. At the Saluda plant of the Lexington Water Power Company four 40,625-kva. vertical-shaft generators were put into operation. An equal number was placed in service at the Fifteen Mile Falls plant of the New England Power Association, each rated at 39,000 kva. All of these machines are of the umbrella type, with the thrust bearing on the shaft below the rotor.

One of the 77,500-kva. vertical-shaft waterwheel gen-



Frame construction for two-pole turbine-generator in which iron pipes of relatively large size are welded to equally spaced steel plates

Rotor of 500-hp. 100-pole vertical-shaft synchronous motor for driving a coal pulverizer



erators for the Dnieper River development in Russia is nearing completion. Nine such machines will be required for that project, five of which are being built in this country. These are the largest capacity waterwheel-driven generators ever constructed, and will operate at 88.25 r.p.m.

The past twelve months witnessed the first hydrogen-cooled turbine-driven generator go into service. It is rated at 9,375 kva. and has been in operation about six months (*Power*, Dec. 23). Because the generator shaft must come through the inclosing case, it was a more difficult problem to apply hydrogen cooling to these machines than to synchronous condensers. An oil seal has been developed for the shaft ends that has satisfactorily solved the problem, and now this system of cooling can be applied to generators as readily as to synchronous condensers.

There has been a gradual migration of machines from inside the power house and substation to outdoors. Oil circuit breakers and transformers led the way. They were followed by hydro-electric units, two plants of this type being added last year to the several already in service. Several hydrogen-cooled synchronous condensers are operated out of doors. Air-cooled synchronous condensers are also being located out of doors. In Canada four 25,000-kva. vertical-shaft machines were placed in service last year in the Toronto Leaside substation of the Hydro-Electric Commission of Ontario. A 7,500-kva. unit for outdoor operation was installed by the Central Illinois Public Service Company.

Further development along these lines, announced last year, were two frequency-changer sets. The generators on these machines are as large physically as any of this type ever built and are wound for single phase. They will supply power to the newly electrified Reading Railroad and will be located near Philadelphia. Each unit will be sheltered under a steel shell 64 ft. long x 25 ft. wide, electrically welded into eight sections, bolted together so that any section may be readily removed if necessary.

A new oil circuit breaker was announced early in the year, known as the deion-grid type. The breaker looks very much like the conventional type of oil switch, except for the contact assembly, which is of a special design to draw the arc through stacks of deionizing grids. The latter consists of stacks of plates made of insulating material with iron plates between them. In one side of the grid stacks is a slot through which the movable contact operates. When the switch opens under load the magnetic field blows the arc in such a way that it is quickly deionized and interrupted.

New System of Motor Control

One of the outstanding developments in motor applications was a new system of control for alternating-current motors. This is a combination alternating-current and direct-current system, consisting of a drive and a regulating unit. The drive unit comprises a constant-speed alternating-current motor, and an adjustable-speed direct-current motor. Both the rotor and the frame of the alternating-current motor are mounted in bearings. The direct-current machine is mechanically connected to the frame of the alternating-current motor so that the direct-current machine may drive or be driven by the stator frame. A regulating set, consisting of an alternating-current motor and a direct-current generator of equivalent capacity to the direct-current motor on the drive unit is connected electrically to it. The shaft

speed of the alternating-current motor on the drive unit is increased by using the direct-current motor to rotate its frame in the same direction as the rotor. The shaft speed is decreased by rotating the stator frame in an opposite direction to that of the rotor. The direction of rotation and the speed of the stator frame are controlled by adjusting the voltage impressed on the armature of the direct-current-drive machine by the generator of the motor-generator set.

A number of new designs of synchronous motors were announced. Several totally inclosed fan-cooled motors of that type were built for operation in the acid room of a paper mill. The system of cooling follows closely that used on totally inclosed fan-cooled induction motors.

Three totally inclosed synchronous motors of special design were built for driving air compressors in an oil refinery. Because of the explosive nature of the atmosphere surrounding the motors, a special arrangement of split seal is used around the shaft to permit maintaining a low pressure of inert gas within the machines, thus minimizing the fire hazard.

To improve starting characteristics of slow-speed synchronous motors, a new high-torque type has been developed. This motor has starting and accelerating characteristics similar to a wound-rotor induction motor. The usual cage-type damper winding in the pole faces has been replaced by an insulated phase-connected winding. The ends of the latter are brought to slip rings, permitting the use of a variable external starting resistor similar to that employed with wound-rotor induction motors. This resistor is automatically cut out in steps by the controller, and when synchronous speed is approached direct-current excitation is applied and the motor synchronizes.

A 500-hp., 72-r.p.m., 100-pole synchronous motor was built for mounting in the base of a coal pulverizer. In order to meet the limited dimensions a special fabricated construction was used. High torque at starting and during acceleration is obtained by over-voltage starting.

Synchronous motors have until recently been considered inherently single-speed machines. However, two-speed motors of that type have been put into operation, and during the year it was announced that a three-speed type was being developed.

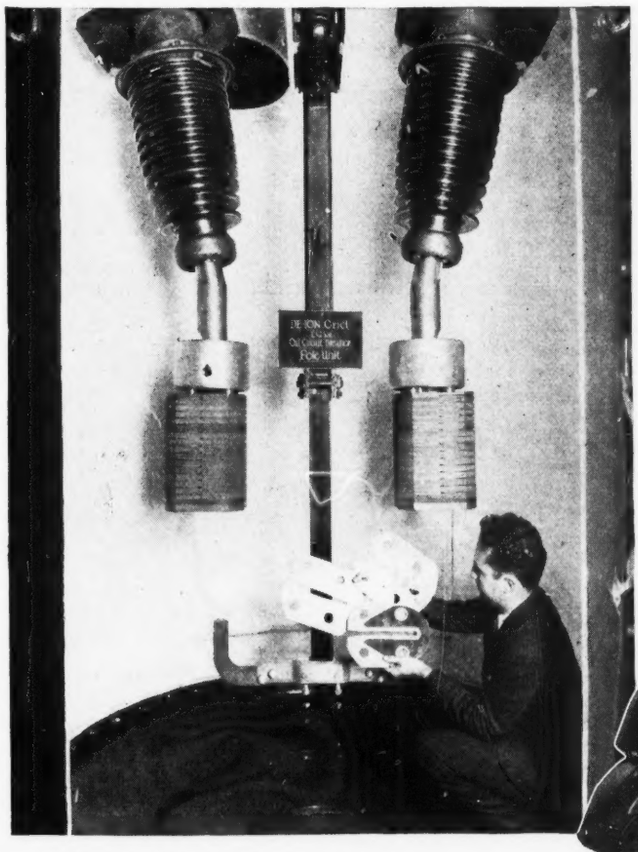
Mercury-Arc Rectifiers Gaining Favor

The large metal-clad mercury-arc power rectifier has had a phenomenal growth in this country during the last few years. At this time it gives promise of eventually superseding the rotary converter. One company announces that it is the principal converting unit for railway operation, although for some applications there is a demand for synchronous converters.

Projects were initiated during the year involving a total of approximately 150,000 kw. capacity of mercury rectifiers. Within the last few years one electrical manufacturing company has made a total of 56 such installations in the United States and Canada. Each installation includes from one to five units. They are used on railway, industrial power and public building loads, and operate on alternating-current at voltages ranging from 2,300 to 60,000. The direct-current voltages range from 240 to 1,500. In regard to direct-current voltages, rectifiers have operated at 30,000 volts in laboratories and have been in operation for some time at 13,000 volts in several broadcasting stations. For power purposes mercury-arc rectifiers range in size up to 6,500 kw.

There is a new field where rectifiers will probably soon be favorably received, namely, 250-volt systems in small industrial plants, department stores and large office buildings. Two such installations are found in the Henry Morgan and the Sun Life Assurance Buildings in Montreal, Canada.

An important new development is the voltage control of rectifiers by means of energized grids. It is simple compared with other methods, such as tap changing under load, induction regulators and other means. It permits of raising and lowering the voltage so as to give the rectifier any desired voltage characteristic, for purpose of load control, voltage regulation, and protection. This control will make rectifiers specially applicable to variable-speed drives.



Stacks of deion-grids on the contacts of a large high-voltage oil circuit breaker to assist in interrupting the arc

Weatherproof vertical hollow-shaft induction motor for outdoor service driving deep-well pumps

Higher Car Speeds Proposed for Elevators

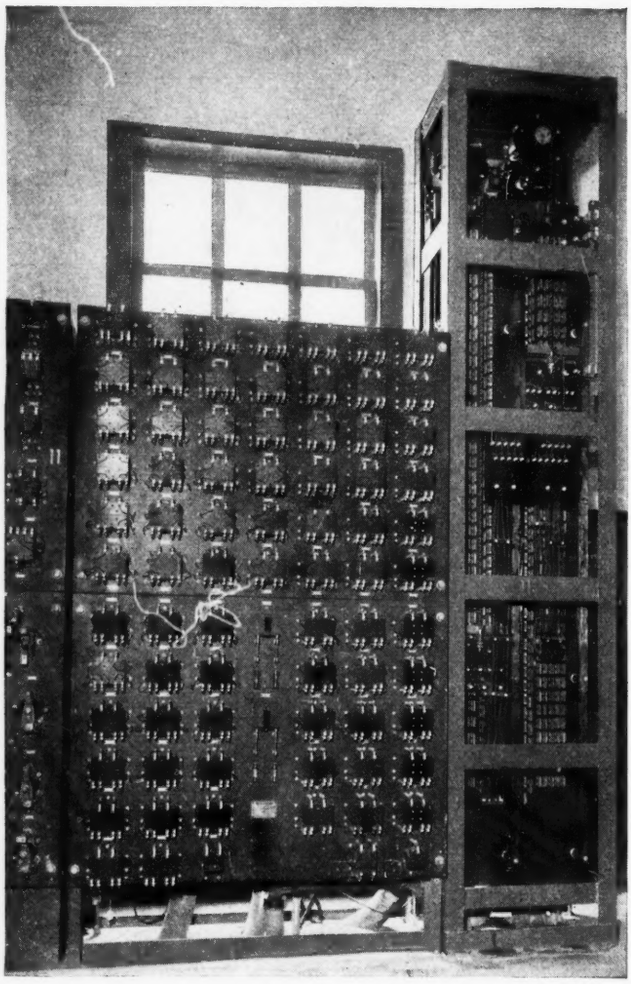
Car speeds of 1,200 ft. per minute; double-deck cars serving two floors at a time; local and express cars in the same hoistway—there are some of the developments nearing accomplishment

DURING the past twelve months the outstanding developments in the elevator industry were the proposals made for solving the transportation problems in skyscraper office buildings. How high buildings may be constructed no one is prepared to say. A building a mile high with a welded steel structure has been visualized by one engineer. Tentative plans have been drawn for a building in New York City covering two blocks and to be 150 stories high. Buildings 100 stories high and over seem to be an imminent possibility.

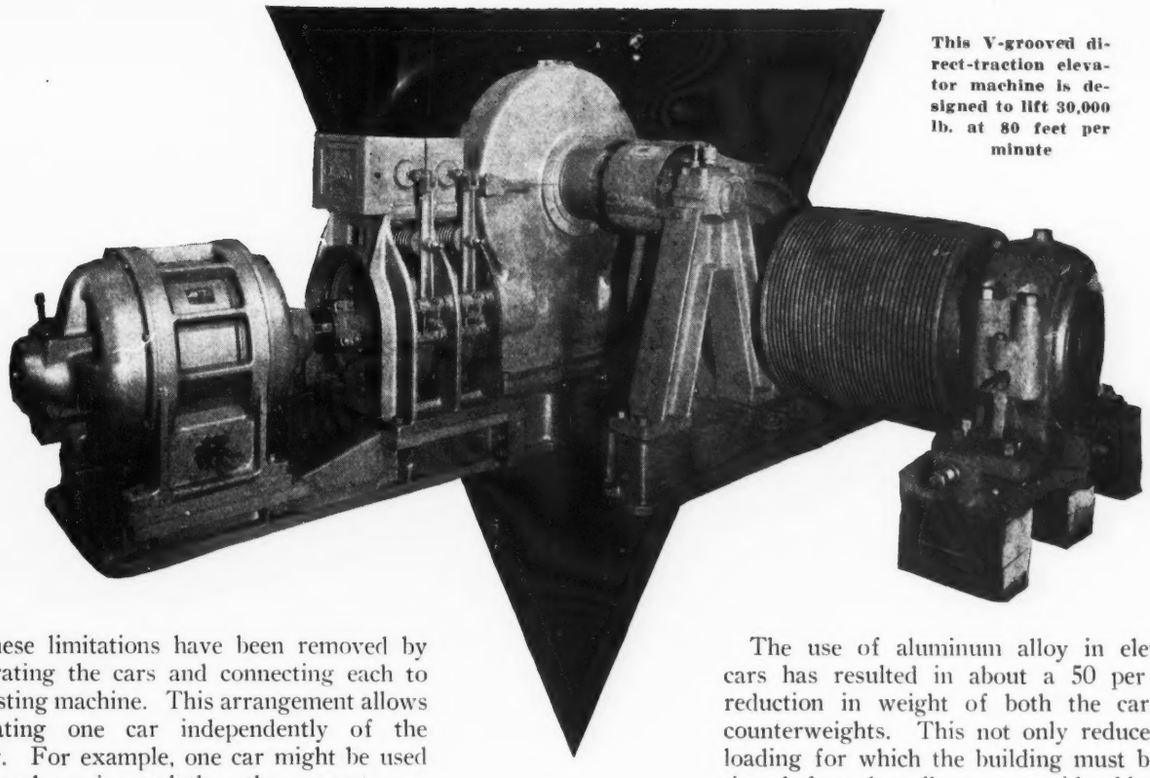
In structures of this kind vertical-transportation is the most difficult problem. It must be solved in a way that will make the building an economic venture financially. The higher the building the more space required for the elevators to serve the upper floors. Approximately 6,000 sq.ft. of floor area is required to provide space for one elevator car to run to the 100th floor of a building. The more elevator service that can be put into this space the greater the possibilities are of making the building a success financially. Among the methods proposed for doing this is increasing the speed of the cars; operating double-deck cars; operating two cars—such as one express and one local—in the same hoistway; and operating express elevators from the ground level to some upper floor where the passenger will transfer to other elevators serving the upper floors.

As an indication of what the elevator problem is in a modern building, the Empire State Building now nearing completion in New York City is a good example. This building is the highest structure ever erected. It has 86 stories above street level, and, including the 200-ft. airship mooring mast, is 1,243 ft. high. The estimated population is 25,000, with an additional transient population of 60,000. There are 58 main passenger elevators and 6 freight elevators. Of the 58 passenger elevators, 54 are express cars, the latter serving from the 6th to the 80th floors, inclusive. The express elevators will operate at car speeds of 800, 1,000 and 1,200 ft. per minute, depending upon the height of a car's travel. These elevators have been selected on the premise that the New York City building code will be changed in the near future to allow car speeds above 700 ft. per minute.

A second means proposed to obtain more elevator service from a given hoistway is the use of double-deck cars. To do this with the present designs of cars, all floors served must be the same distance apart, so that when the lower car is level with one floor the top car will be at the floor above. However, it is not impossible to provide means of adjusting the distance between the cars. In the Cities Service Building, now under construction in New York City, eight elevators with double-deck cars are being installed. With this system the passengers at the ground floor must be loaded at two levels. The lower car will be loaded at a level below the ground floor and the upper car at a level a few feet above this floor. One car will serve even-numbered floors and the other odd-numbered floors. One of the objections to double-deck cars is that both cars must operate at the same speed and they are limited to serving the same zone in the building.



The floor selector switch shown on the right of the control board is driven electrically by a self-synchronizing motor



This V-grooved direct-traction elevator machine is designed to lift 30,000 lb. at 80 feet per minute

These limitations have been removed by separating the cars and connecting each to a hoisting machine. This arrangement allows operating one car independently of the other. For example, one car might be used for local service and the other operate express at lower floors and local at intermediate or top floors. The two cars might also be used for express service, the bottom car serving an intermediate zone and the top car a higher zone in the building. Although up to this time no commercial installations have been announced, a test installation has been made and the safety of such an arrangement has been definitely established.

For very high buildings, zoning the floors has been proposed. With this arrangement a bank of high-speed express elevators would deliver the passengers to an upper zone, from where they would be transported by another bank of elevators serving the upper floors. The nearest approach so far to this plan is the tower elevators in some of the highest buildings. For example, in the Empire State Building, one bank of express elevators runs to the 80th floor. From the 79th to the 86th two local elevators are operated.

Where one company occupies several floors in the same building it generally causes a large interfloor traffic that may seriously affect elevator service to the other floors. To take care of interfloor traffic under these conditions escalators are being used. This equipment is also being installed in department stores to handle the heavy interfloor traffic and relieve the elevators for high-rise duty.

On automatic elevators a floor selector switch is required. This switch has to be driven by some means that will maintain a fixed relation between the position of the car and the floor selector. The usual way of doing this has been by a mechanical connection between the car or the elevator machine and the the selector switch. An electrical drive for this switch has been developed that consists of two self-synchronizing motors connected together. One of the motors is mounted on the selector switch and geared to its shaft. The other motor is geared to the secondary sheave. As the rotor of the motor on the secondary sheave turns, that on the selector turns in synchronism with it. This drive allows locating the selector switches in any convenient place or banking them with the control panels.

The use of aluminum alloy in elevator cars has resulted in about a 50 per cent reduction in weight of both the car and counterweights. This not only reduces the loading for which the building must be designed, but also allows a considerable saving in power per car-mile of operation. In the interior of the cabs, aluminum, when used with other suitable materials, is capable of being worked into pleasing effects. Hoistway doors are also being constructed of the same material as the car, with a 50 per cent reduction in weight over steel doors.

There is a decided tendency toward the use of auxiliary equipments to improve elevator operation. One of these is automatic scheduling of the cars. The car operators are automatically signaled when to leave the ground floor, the top landing and when they should be half way down the hoistway. In this way the cars are kept equally spaced in the hoistway and a uniform service rendered. These equipments are adjusted by the dispatcher to suit the number of cars in service. Along with automatic scheduling of the cars the use of car-position indicators and telltale annunciators are finding wider application.

Power door operators are also coming into more general use. These equipments are not only applied to high-speed cars but also to apartment house and other medium- and slow-speed elevators. The foregoing developments and others indicate a growing appreciation among those connected with building construction and operation of the economic value of making elevator equipment as nearly automatic as possible.

The use of automatic equalizers on the hoisting ropes of traction machines is increasing rapidly. Although originally developed for equalizing the load on the hoisting ropes, this equipment is now being applied to the compensating ropes. On the hoisting ropes the automatic equalizer is usually installed in the car's crosshead, but a modified form of this equipment has been developed to be used on the counterweight ends of the ropes, along with the one on the car end.

To operate elevators intelligently it is necessary that proper records be kept of what each car is doing. To this end a wider use is being made of watt-hour meters, mileage recorders and stop counters.

Refrigeration Turns to New Applications

Basically refrigeration engineering has shown no marked advances during the year, but in application of refrigeration what might be termed revolutionary changes occurred

DURING the year the success obtained by quick-freezing of fish in New England encouraged the design and construction of a quick-freezing plant in Georgia for the preparation of ripe peaches.

The initial plant has proved successful, and plans are in preparation for a large installation. The ability to market, throughout the year, a tree-ripened fruit will broaden the field for refrigerating equipment, which is suffering from the inroads of the household machine.

A novel feature of the quick-freezing plant is the use of both ammonia and carbon dioxide. While it is possible theoretically to employ one refrigerant, the loss in economy that would result in compression to a point where the refrigerant would liquefy at atmospheric temperature is such that the two-step system works out better. In the plant referred to the carbon dioxide is used to cool air to —50 deg. F., which is blown across the fruit as the latter passes through a tunnel. The CO_2 vapor is compressed to 345 lb. pressure and discharged into a condenser, where it is cooled by evaporating ammonia. The latter is then compressed and condensed by ordinary cooling water.

While the prior fish freezing initiated the movement, fruit freezing has for the refrigerating engineer greater opportunities. This is evidenced by the activity shown by orange and grapefruit marketers, and already plans are under way to sharp-freeze ripe orange and grapefruit juices for general distribution. For some time orange juice has been extracted and marketed to hotels, but the claim has been made that shortly after extraction a chemical change sets in to reduce the value of the juice. Quick-freezing will prevent this.

Necessity of maintaining a below-melting temperature of quick-frozen produce while in transit has led to various studies of new methods of car refrigeration. The use of silica gel has been extended until a number of cars are in service employing that system. "Dry ice" has been applied to fish cars with satisfaction, after the problem of correct air circulation was solved. The expense, however, indicates that CO_2 ice will not completely meet the requirements.

However, the cost of manufacturing dry ice has been so reduced that its use has been extended into many fields from which it had been excluded in the past because of its high cost. The situation has been somewhat disturbed by the introduction of natural CO_2 obtained from Mexico. While drilling for oil, CO_2 gas was encountered at such high pressures that upon being allowed to escape to the atmosphere dry ice was formed. So little sulphur was present that the frozen CO_2 was deemed to be marketable, and at least two cargoes were shipped to New York City. It is impossible to estimate the future influence of the natural CO_2, but undoubtedly it will cause makers of the artificial product to reduce their manufacturing costs. That dry ice will come into increasing favor as the refrigerant for frozen fruits in transit is conceded by those in touch with the developments.

Two vertical compressors driven by a six-cylinder oil engine. One machine is provided with a movable cylinder head for clearance - volume control, while the second is designed to operate with two suction pressures. This arrangement will permit the engine to run at constant speed at a wide range in compressor output

Another line of approach has been the use of small compression machines. One of these units is installed in one end of the refrigerator car, with the compressor driven from the car axle and with an air-cooled condenser on the roof. Delay in travel of any duration could, it is claimed, be rendered unobjectionable by the employment of brine from a terminal plant. The real objection raised is that the efficiency of a locomotive is at best not over 10 or 12 per cent, and this is further reduced by transmission loss before it reaches the refrigerator compressor. However, the ability to hold a car at low temperature may fully justify the system in spite of its low efficiency.

In the smaller sizes, improvements have been made in existing household machines, and a new system, employing water vapor and mercury, has been announced. The new machine is gas-fired, and mercury is evaporated at 700 deg. F. to be used as the vacuum-producing agent to lower the water temperature.

Advances in the larger commercial machines have been, in the main, made up of improvements in design details.

The advantages of variable clearance have become so evident where electric drive is employed that most compressor builders have evolved some form of clearance control. One design brought out during the year includes an adjustable cylinder head to give the necessary clearance variation. Another design has a valve pocket bolted to the side of a single-acting cylinder, while a third single-acting machine is provided with a bypass which when open permits gas to flow back into the suction until the piston covers the bypass port.

There is an indication that the future compressor will be run at high speeds. With the general adoption of synchronous motors, the reduction in motor and compressor costs with speed increases will cause speed of 600 r.p.m. to become general. Compressor designers are faced with the same problem as were automotive engineers a few years ago, and the high speeds can be obtained by the adoption of special steels and lighter reciprocating parts.

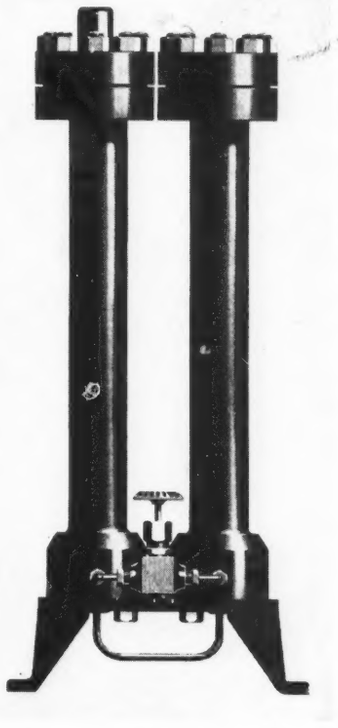
Modernization of refrigerating practice has been most noticeable in temperature-control apparatus. Installation of small ice plants close to centers of consumption, in preference to one large plant, involved the use of more labor as long as manual control was the practice. To make a plant as automatic as possible various manufacturers have produced control valves to regulate pressures and temperatures. At present a plant can be made entirely automatic beyond the labor needed to fill and pull the ice cans.

In industry, refrigeration has found increased applications, both to maintain a human-comfort temperature and to raise the quality of a product or increase the output of a factory.

Air conditioning has become an accepted necessity for theaters and is entering the store and hotel field. Some home applications of a combined heating and air-conditioning system were made during 1930, but general adoption of this idea is hindered by the present cost of the equipment and the relatively high price of gas for heating.

There are, however, a great number of homes where the financial status is such that an increase in fuel costs will not be objectionable if it brings a heretofore unknown degree of bodily comfort. In addition, some furnace manufacturers are developing special designs in which the gas passages are long enough to reduce the exit temperatures to low values, thus raising the furnace efficiency.

More Sturdy Instruments



Flow meter body built for 5,000 lb. working pressure

THE PROCESS of developing and perfecting power plant instruments continued during 1930. Several recording flow meters, designed for regular operation under pressures as high as 5,000 lb. per square inch, were put on the market, as was an indicating gage designed to read as high as 10,000 lb. under severe service conditions. Drop forgings, special alloy steels, and new types of construction were employed.

Among the new instruments placed on the market were a humidity recorder and a 34-tube draft gage for the zone draft control of underfeed stokers.

The general tendency to install automatic combustion and other automatic control systems continued.

Builders of gage glass columns were able to keep ahead of the demands of high-pressure plans. During the year flat glass plate water gages were marketed for pressures as high as 1,800 lb. Another type of gage used flat mica only, and was sold for pressures as high as 2,000 pounds.

In general, instrument builders, by refinement of design and construction, are achieving greater precision and reliability in the face of more operating conditions that are becoming more severe.

High Pressures Affect Heat-Exchanger Design

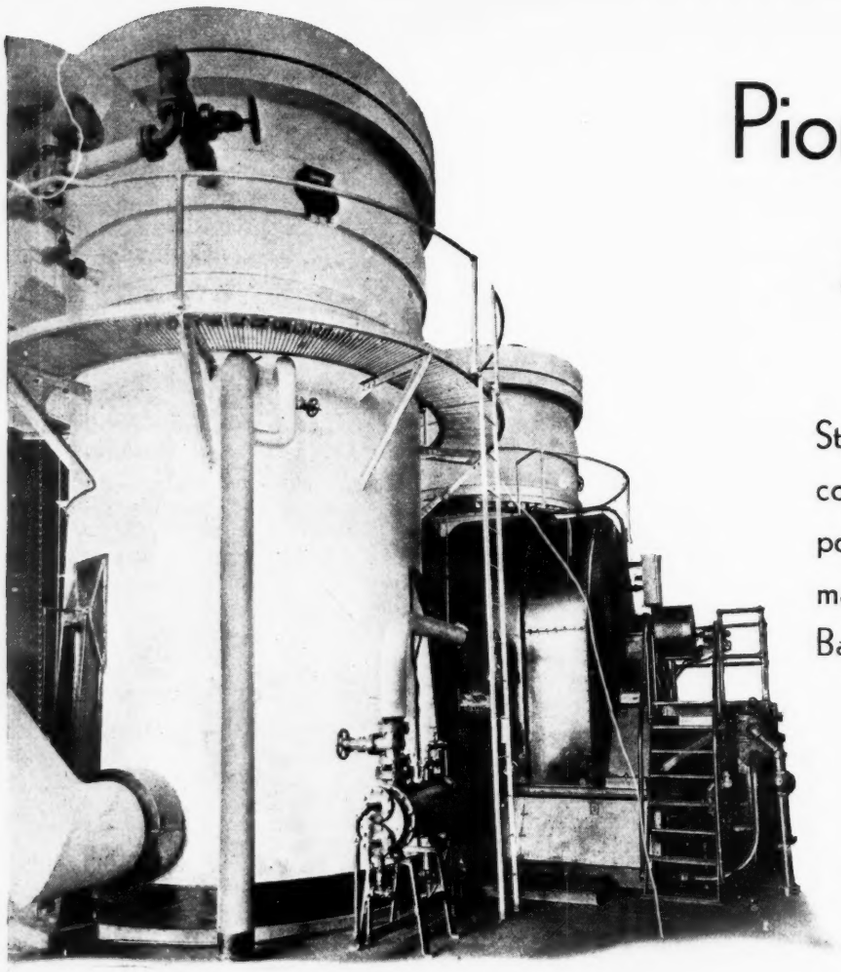
THE INCREASING USE of high steam pressures has had a definite effect upon the design and construction of closed and open heaters. One manufacturer of closed heaters advises that he is drilling tube sheets of steel so thick that it takes 15 min. to complete a single hole. Alloy steel bolts in very large forgings, growing to the thickness of 4 or 5 in., are being used in this construction. This, of course, is merely a continuation of developments of previous years.

Another development was the application of the open-type feed-water heater to higher pressures. This was made possible by the adoption of cylindrical heater sections having a minimum of joints.

An increasing tendency to accept welding on all types of heat-transfer apparatus was noted. At present it appears that code restrictions alone limit the universal application of this process.

Pioneer Projects Advance

Steam-mercury plant operates commercially. Claude extracts power from sea heat. Koenemann cycle opens new vistas. Baumann proposes multiple-superheater boiler



From Feb. 4 to Dec. 14 the mercury installation at Hartford averaged 10,300 B.t.u. in fuel per net kilowatt-hour

HAND in hand with a healthy development of "standard" practice during the year went continued exploration of new fields. Pioneer minds, not satisfied with the perfecting of normal processes, followed unbeaten paths. The results in some cases hold promise of early practical application. Others seem far from the day of commercial return, but progressive engineers follow them with unabated interest as the best insurance against future stagnation.

The mercury-steam plant in the South Meadow station of the Hartford Electric Light Company demonstrated during the year not only technical success, but, in the opinion of its backers, commercial success. A report printed in July gave the performance of the latest unit from Feb. 4 to June 4, inclusive. During that period 36,911,930 kw.-hr. (net) was produced by the mercury turbine and by the steam produced in its condenser. The coal rate on this net output was 0.7146 lb. per kilowatt-hour. A more recent statement reports operation from Feb. 4 to Dec. 14 with an average net heat consumption of 10,300 B.t.u. per kilowatt-hour.

The General Electric Company has announced plans for the installation of a 20,000-kw. mercury installation in its own power plant at Schenectady. This unit, although twice the capacity of the one at Hartford, can be installed in the same space. Doubling the capacity will be obtained by increasing the mercury pressure from 70 lb. to 125 lb. With an efficient steam turbine operating at 400 lb. pressure the expected heat rate is 8,800 B.t.u. per net kilowatt-hour.

The impression of many engineers that mercury is the only fluid suitable for use with water in a binary-vapor cycle may require modification as the result of a sensational proposal made by Dr.-Ing. E. Koenemann of Germany. The cycle proposed by Dr. Koenemann utilizes ammonia for the upper fluid and water for the lower. This order might seem illogical, in view of the higher vapor pressure of ammonia for a given temperature. Dr. Koenemann, however, does not propose to produce this vapor by the evaporation of liquid anhydrous ammonia, or by driving it off from a water solution. His plan, rather, involves the introduction of chemical reactions into the power cycle.

Koenemann Uses a Chemical Cycle

Dr. Koenemann's scheme calls for the heating of so-called "zinc chloride ammoniacates" (water free) in the primary boiler. The heat separates the ammonia gas from the zinc chloride and produces a highly superheated vapor immediately without the aid of the superheating process. It thereby achieves the aim of all highly efficient cycles—introduction of the mass of the heat at a high temperature.

The provisions made for transferring the exhaust heat of the ammonia turbine to the water boiler cannot easily be explained without a diagram, such as that shown in the Oct. 28 number of *Power*. It involves, however, the use of a jet condenser as mixer, and the re-absorption of ammonia vapor by dilute ammoniacates.

Dr. Koenemann claimed that this cycle will approach

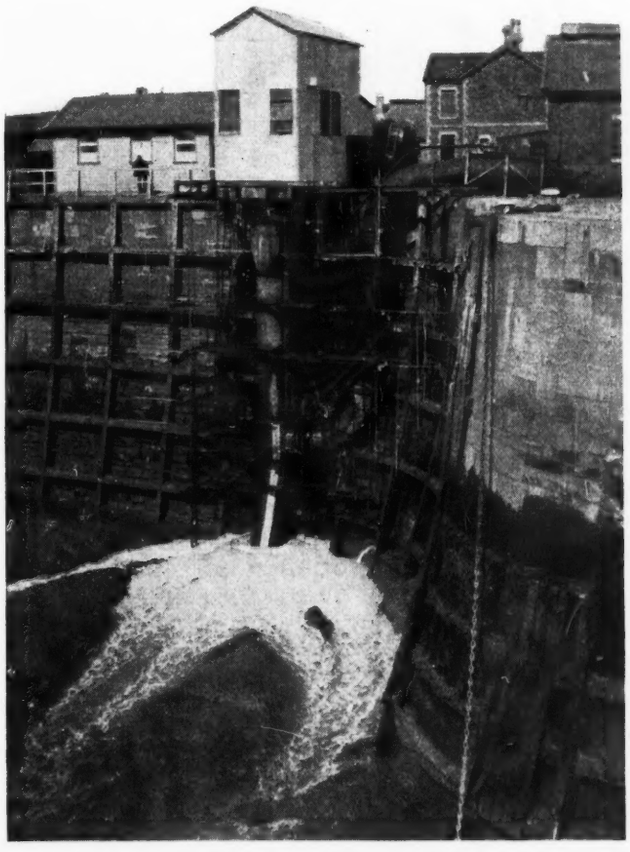
the mercury-steam cycle in efficiency, and will have the great advantage of utilizing substances available at low cost and in unlimited quantities. He saw no unsurmountable practical difficulties in the use of ammonia.

The Koenemann proposal opens up unlimited possibilities for the use of other combinations requiring heat for break-up. The natural result should be an intensive study of many such compounds by power engineers.

The growing importance of the chemist to the power engineer is also illustrated by the proposal, made during 1930, that "diphenyl"—a substance solid at room temperatures and having a low vapor pressure—be used as a medium for reheating steam in high-pressure plants. This substance has already been successfully applied to high-temperature processes. Diphenyl oxide, which should not be confused with diphenyl, will actually be used for reheating steam between the 1,400 lb. and the 400 lb. turbines in a new plant now under construction.

Claude Taps Ocean Heat

Perhaps the most dramatic incident of the year in the power field was the completion and operation by Georges Claude, famous French scientist, of his experimental plant utilizing the difference in temperature between surface water and deep water in tropical seas for the generation of power. True, this plant, located at Matanzas, in Cuba, required an auxiliary power consumption of 80 kw. to produce 22 kw. at the turbine, leaving a net deficit of 58 kw. In a speech made at New York, after his return from Cuba, Doctor Claude vigorously assailed critics who pointed to this ratio as a proof of practical failure. He stated that the turbine did not permit the generation of more power, and that the auxiliary power used would have supplied a turbine generating at least ten times as much power.



British tide-power plant stores excess power as hot water under pressure, which is later flashed into steam for power generation

After two costly failures, Claude's great tube, 6½ ft. in diameter and 1¼ miles long, was successfully laid from the top of a cliff at Matanzas down and out along the ocean bed to a depth of nearly 2,000 feet.

The inventor announced plans for a 25,000-kw. sea-heat power plant to be built near San Diego, Cuba, and predicted an ultimate cost for such plants of $60 per net kilowatt. Claude's scheme involves the continual circulation of tepid surface water into an open boiling chamber and back to waste. Paired with this is a condensing chamber, to which cold water, pumped from the depths, is circulated. A pipe passes from the boiling chamber to a steam turbine, and from this to the condensing chamber. After vacuum has been originally established in the condensing chamber by means of an air pump, vapor is given off by the warm water in the boiling chamber, and is condensed by the cold water.

While there is still much skepticism regarding the commercial possibilities of sea-heat power plants there is a growing admiration of Doctor Claude's indomitable determination and the sincere hope that his spectacular accomplishments in other fields may be repeated in the realm of power.

A decidedly interesting British application of thermal storage was described last year. Excess power produced at low water by a tide power plant is absorbed by a special brake which raises water under pressure to a temperature of 390 deg. F. When tide-power capacity is less than the demand, some of the accumulated hot water is flashed into steam for operation of a turbine.

This method of storage has, of course, a definite limitation in the matter of efficiency; most of the heat developed in the water brake is necessarily rejected in the exhaust of the steam turbine. Pumped storage, where applicable, gives much better utilization of energy.

Other proposals and achievements of the year, less sensational, were still of sufficient novelty to excite considerable interest among engineers.

Multiple-Superheater Boiler

For example, K. Baumann, in a paper presented before the Northwestern Branch of the Institution of Mechanical Engineers, proposed a multiple-superheater boiler designed to eliminate superheat variations. In this boiler all water-heating surface, except furnace water walls, is eliminated. Saturated steam passes to a primary superheater, and from this to a desuperheater, the amount of desuperheat being controllable by the water level. The partly desuperheated steam passes to a second superheater, and thence to the turbine. Steam produced by evaporation of water in the desuperheater is passed back to the boiler drum, whence it goes with the newly generated steam to the primary superheater.

By controlling the desuperheat the final superheat can be kept constant, it was claimed by Mr. Baumann. He pointed out that at high pressures the heat in superheat represents such a considerable portion of the total that a boiler of this type should show a good efficiency.

The purpose of the multiple-superheater boiler and all other devices for maintaining constant superheat is to permit a higher normal operating superheat without danger of exceeding the safe limit. This, of course, means higher plant efficiency.

Steady Progress Marks European Power Activities

Three 50,000-kw. turbines being installed for 775-lb. 920 deg. F. steam. Designs completed for 25,000-hp. diesel engine. Reaction-type waterwheels operating under an effective head of 920 feet

THERE have been no extraordinary developments in European power plant design during the past year. A series of interesting events have, however, taken place and their combined effect has created impressively the feeling that all of Europe is very much alive to power as a factor in material and cultural progress.

The Second World Power Conference held at Berlin in June brought engineers from all parts of the world to present records of the development of power and improvements in the art of its production. The International Steam Tables Conference also held a most important session contemporaneously with the Power Conference. As a result, international tolerances for steam-table values were agreed upon and the way was definitely cleared for international agreement in steam calculations.

In July the International Electrotechnical Commission convened in plenary session in Stockholm, where splendid progress was made in the establishment of international standards under which it will be possible for non-manufacturing countries to receive bids for power-generating machinery from any manufacturing country upon a comparable basis. Another important step has been the change of the status of the International Commission for the Study of Large Dams, in which the commission has agreed to affiliate with the World Power Conference. For this purpose a new constitution has been adopted and the name changed to the International Commission on Large Dams of the World Power Conference.

Higher Pressures and Temperatures

FROM the sessions of the various conferences there have come a number of interesting ideas, and certain definite trends can be discerned. Of these one of the most interesting is the increasing use of high steam temperatures in Germany and France. A temperature of 850 deg. F. is regarded as practicable and 920 deg. F. is making an appearance under conditions in which it is stated there is no necessity for the use of special alloy steels. In France the St. Denis station of the Societe de Electricite de Paris is putting in three 50,000-kw. turbines having steam pressure of 775 lb. at a total temperature of 840 to 920 deg. F.

There has been some further development of high-pressure boilers, such as the Benson and the Loeffler, but no sweeping indication of their general adoption is apparent. The Ljungstrom turbine is gaining in popularity, and one 50,000-kva. machine understood to be of the radial type has been installed at the Vasteras station, not far from Stockholm, in Sweden.

English manufacturers are inclined to favor pressure ranges of 450 to 600 lb., with total temperatures of approximately 750 deg. F. An important argument that they present in dealing with the subject of high temperatures and pressures is the effect of "creep" upon the life of the steel used in tube and drum construction under these conditions.

Fly Ash and Smoke Nuisance

IT IS said that the increasing objections of the public to dirt and fly ash throughout Europe generally are responsible for a growing tendency to use stokers in new boiler construction. Some, however, are installing boilers fitted with stokers and for pulverized-fuel burning, in the same plant, as by this plan it is possible to obtain the operating advantages of both under variable load conditions.

The past year saw a marked increase of activity on the part of the people in curbing the smoke, flue dust and sulphur nuisances from power-generating plants. This attitude is being met by the power companies with determined efforts to reduce the cause for complaint. Germany has heretofore recognized the possible nuisance by building chimneys of 350 to 400 ft. height and in some cases even higher. They are now going more deeply into the problem, and various devices for dust elimination are being tried out. The electrical precipitation process is the most effective method so far. Plants burning coal of high sulphur content have the additional problem of removing the sulphur from the stack gases. The outstanding development in that direction is the

Battersea plant of the London Power Company, on the Thames River, not far from Westminster Abbey. Permission to install this plant was granted only upon agreement of the owners to provide means for so treating the gases as to remove their objectionable qualities. This is being accomplished by the installation of elaborate washing methods which are the result of extensive research and experiment by leading experts. The problem of atmospheric pollution is also receiving serious attention in France and Belgium.

Chemistry and Thermodynamics Combine in New Cycle

ALTHOUGH in an early stage of development, the Koenemann binary-vapor cycle is being considerably discussed, as it is felt that it offers great possibilities and may be the precursor of other heat cycles joining chemistry to thermodynamics. Thermal-storage plants, notably of the Ruth's accumulator type, find favor in many directions. The large installation of Ruth's accumulators at the Charlottenburg plant of the Berlin Electricity Works has been running now for a little more than a year and, according to reports, is doing all that was promised.

The combination low-temperature carbonization and electric plant idea has made little progress during the year, although European economic conditions generally favor this type of installation more than do conditions in the United States.

The work of the Central Electricity Board of England is going on apace. The provisions of the act creating the board and setting forth its purpose are being carefully followed and with remarkably little friction, considering the revolutionary nature of the program that is being put into effect. The grid system of transmission network being set up will virtually blanket central Scotland, England and north Wales with a unified power system fed at various points by suitable power plants, some of which previously existed and others newly built, so that all districts will be provided with a supply of power commensurate with their domestic and industrial needs.

The administration of the Central Electricity Board has been called upon frequently to make decisions affecting huge expenditures and involving such vital questions as the complete standardization of frequencies and voltages. So far as it is known, these decisions have been rendered in favor of a uniform and highly standardized system, despite the increases of cost that have been necessary to carry out the plan. The significant thing about this is seen in the evident realization of the Central Electricity Board that the industrial rehabilitation and future progress of England will not be secured without a forward-looking policy of power production.

Diesel Designs Improve

DIESEL ENGINES are undergoing decided improvement, particularly in the direction of size and reduction of total weight per horsepower generated. These improvements are coming about by the effective combination of several forces. Double-acting, two-stroke-cycle engines in the large sizes are making decided headway. Higher piston speeds are also apparent.

Superchargers, by means of which the output per engine cylinder is increased from 40 to 80 per cent, are also receiving wide attention. Frequently they are operated by means of exhaust gases from the engine and so are effective as power increasers and also in the utilization of the hitherto wasted exhaust-gas power.

Waste-heat boilers utilizing the heat from exhaust gases have in some designs reached a high state of perfection, whereby as an adjunct to a diesel engine plant they may easily become the deciding factor in an economic analysis. The British motorship Britannic has three such boilers, one of which is a spare, supplying the full hot water and steam needs of the ship, with ample safety margin when on run. It is estimated that this waste-heat service saves approximately ten tons of fuel per voyage.

As to size, there are diesel engines operating in Hamburg of 15,000 hp. capacity. At Berlin there are two solid injection diesel engines each developing 11,700 hp. at 215 r.p.m. and connected to a 7,500-kw. generator. This 15,000-kw. plant is used for peak-load service and can be started in less than three minutes by one man, no external electricity supply being needed. The units parallel with the Berlin electricity system, and are cited in particular as they are representative of the service that may be developed for stand-by purposes for central utility systems. A thermal efficiency of 36.8 per cent was secured on test, inclusive of the engine room auxiliaries.

Plans have been completed for a 25,000 b.hp. diesel engine which will have a per horsepower weight approximately two-thirds of the 15,000-hp. Hamburg engines and a piston speed of 1,200 ft. per minute. In the case of some special designs where weight reduction was of primary importance an engine weight of approximately 20 lb. per horsepower has been accomplished. Normal commercial designs have reduced weights to 55 lb. per brake-horsepower in high-speed designs.

Prussia Has Highest-Head Turbine

IN THE FIELD of hydro power it appears that the record for high-head Francis turbine designs has left the United States to reside with the Bringhausen pumped-water storage development in Prussia. This plant has in it four units each with a rated capacity of 40,000 hp. under 928-ft. average effective head and 955-ft. maximum effective head, at which point the output is about 41,800 hp. The maximum gross head for this plant is 1,000 ft. Another high-head Francis turbine plant is in Norway, operating under an effective head of 920 ft. and gross head of 975 feet.

The United States record is believed to rest with the Oak Grove plant of the Pacific Northwest Public Service Company of Portland, Oregon, with an effective head of 860 ft. and a gross head of 930 feet.

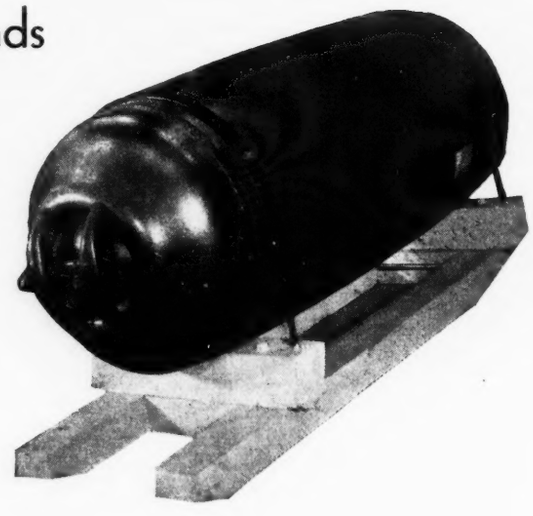
Pumped-water storage plants have been built in considerable number in or about Germany, but have made little headway in economic possibility elsewhere.

The Shannon River power station in Ireland has been in operation for about a year, with a capacity of 90,000 hp. at present. Early reports were doubtful as to whether sufficient load would be found to justify the project. Developments have proved this fear to be unwarranted.

By far the largest European hydro installation is on the Dnieperstroy in Russia. Nine 84,000 hp. units are being installed to operate under 116.5 ft. head. Aside from the exceptional size of these units, the station is of usual design. The 9 waterwheels and 5 of the generators are being furnished by American manufacturers.

A Significant Year in Welding . . .

Commercial Welding of Power Boilers Impends



This fusion-welded test drum, fabricated in the Hedges-Walsh-Weidener shops of the Combustion Engineering Corporation, withstood a hydrostatic test of 3,250 lb. pressure (63,000 lb. per sq. in. fibre stress) without failure

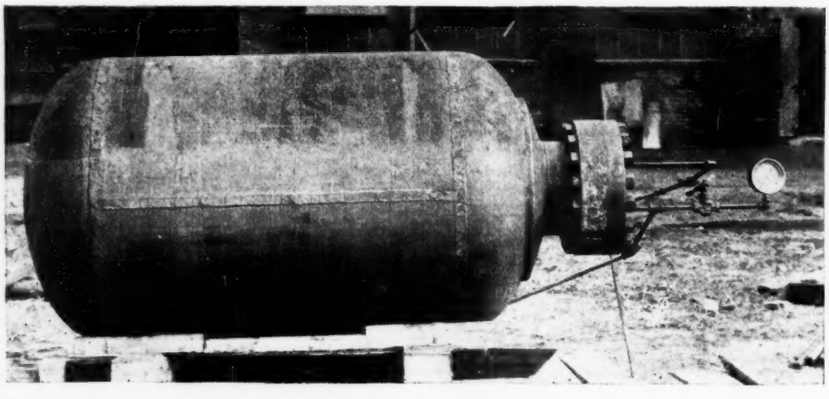
THE OUTSTANDING welding developments of 1930 lay in the closely related fields of pressure vessels and power boilers. Hand in hand with definite progress in the formulation of construction codes by the A.S.M.E. Boiler Code Committee went profound changes in the attitude of the user toward welded vessels and boiler drums and in the ability of manufacturers to turn out, on a large scale, work of the highest grade.

Anticipating the early authorization of a code permitting, under proper restrictions, the use of fusion-welded drums for power boilers, several boiler manufacturers have studied the problem intensively. Technique has been perfected. Elaborate testing equipment has been set up. Equipment for welding and heat relieving on a large scale has been installed. Personnel has been trained. In short, during 1930, some of the largest boiler manufacturers completed preparations to start the manufacture of welded boiler drums as soon as the code permits, and to inaugurate this development with such a thorough knowledge of the problems to be encountered, and their solution, that the results obtained with these drums will fully meet the expectations of users who have been led to expect much of welding.

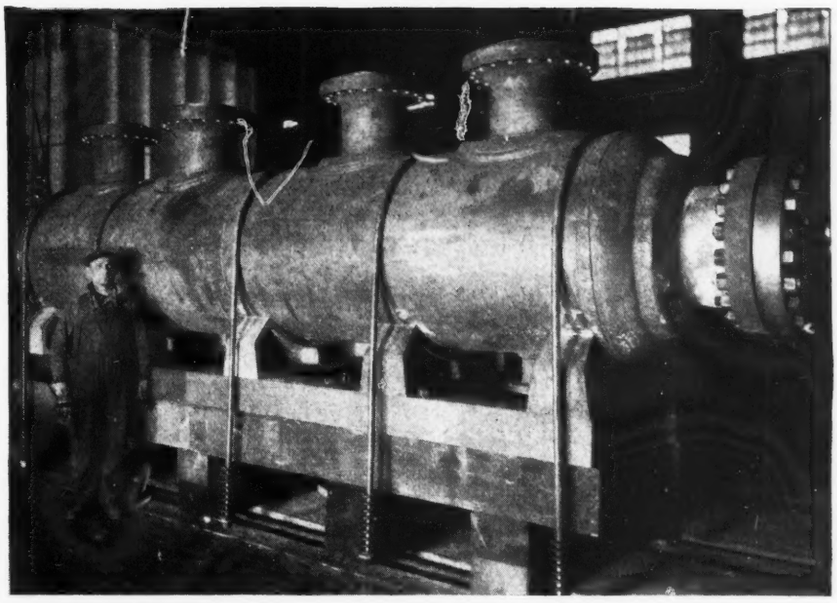
Late in the year one boiler manufacturer announced a United States Navy order for 24 welded-drum boilers for new scout cruisers. This company will manufacture these drums in accordance with an elaborate technique it has developed and will use X-ray examinations and other non-destructive tests as an additional check on the soundness of the welds. This order is perhaps the most important official recognition of boiler welding to date. Undoubtedly treaty limitations of tonnage, with the resulting desire to save weight in ship construction, has been a factor in the navy's interest in fusion welding.

The trend in the welding of boiler drums is toward the use of automatic welding machines, coated electrodes or other means of excluding air from the hot weld metal during the process, and final stress relieving of the completed drum by heating in special ovens.

In the closely allied field of welded pressure vessels for severe service, distinct progress was made during the



Electrically welded test drum, 48 in. I.D. x 1¼ in. thick, fabricated by the M. W. Kellogg Company. Tested to destruction at 3,250 lb. hydrostatic pressure, the girth increased 24¼ in. and the actual stress at time of failure was 72,400 lb. per sq.in.



This electrically welded receiver separator for the Waukegan power station was fabricated by the A. O. Smith Corporation for operation with steam at 730 lb. and 800 deg.

year. One large corporation with years of experience in fabricating welded pressure vessels for the oil, gas and chemical industries experienced during 1930 a growing demand for its products in the steam power field. Notable examples were a welded steam receiver-separator for 730 lb. and 800 deg., a reheater shell for 400 lb. and 750 deg. and eight superheater drums to operate at 300 lb. and 750 deg. A welded drip receiver for 1,450 lb. and 900 deg. was under construction by the same company. This is a chrome-vanadium vessel of 54 in. internal diameter and 3 in. wall thickness.

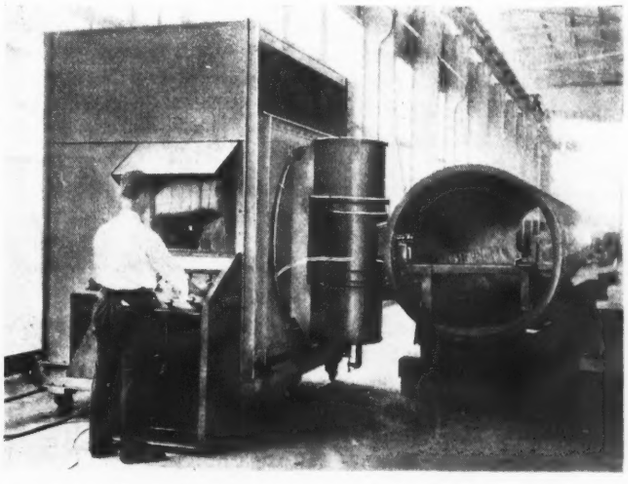
Undoubtedly the experience gained for some years past in the construction of such vessels by certain manufacturers is a distinct aid in the development of welded boiler drums. If and when the A.S.M.E. code authorizes boiler drum welding it is probable that several well-equipped manufacturers of welded pressure vessels may enter the boiler field, at least to the extent of supplying welded drums to boiler manufacturers.

Definite progress was made during the year in the development and application of non-destructive tests of welds. These are not intended to replace the usual destructive tests, but are to give a final check on the safety of the welded vessel itself. Non-destructive tests now recognized include those based on magnetic and electrical conductivity, X ray (radiograph and diffraction), hammer and stethoscope. All of these tests had their beginning before 1930, but the year saw a great extension in their application.

Boiler and pressure-vessel code developments of the year included the authorization of a more liberal code for the construction of pressure vessels. The new A.S.M.E. code for air vessels extended the diameter limit to 60 lb., the pressure limit to 200 lb. and the unit stress to 8,000 lb. per square inch, these extended limits being made contingent upon the use by the manufacturer of a recommended procedure for welding.

During the year a suggested code for welded boiler drums was published as a "feeler" to draw comments. As a result of such comments, much progress has been made in preparing a final draft of this code. A byproduct of this work has been the development of a new code for pressure vessels designed for very severe service. This code, incorporating many of the features suggested for boiler welding, is nearing final form. The field in general expects that 1931 will see the publication of an authorized code for welded boiler drums. Such action will undoubtedly be followed by a highly important commercial expansion in this field.

While the most spectacular and significant welding developments of the year were in connection with pressure vessels and boiler drums, the progress was by no means limited to those fields. The building of a large welded surface condenser was mentioned in last year's review. This year at least seven such condensers are under construction or on order, and many inquiries regarding welded condensers have been directed to manufacturers.



Installed in the Barberton plant of the Babcock & Wilcox Company, this X-Ray machine is used for routine inspection of welded drum joints

Manufacturers and users alike report an increasing tendency to accept welding on all types of heat-transfer apparatus where the code permits. In fact, the code restrictions are about all that prevents the general use of welding for such purposes.

In the field of power piping, receivers, etc., there was the same general extension of welding application. Notable accomplishments reported by one company in that field include the fabrication of a steam manifold for the Deepwater station of the American Gas & Electric Company, designed for 1,350 lb. and 750 degrees.

Interest Extending in Smoke and Dust Elimination

THERE ARE unmistakable signs of quickening interest in smoke abatement and stack-dust elimination. Abroad, public opinion has gone further than in this country, but there is every indication that here, unless plant owners take the initiative in solving the problem, they are likely to be the prey of political or social demagogues.

The two hundred or more municipal smoke ordinances already in force have been augmented by an ordinance for the entire Commonwealth of Massachusetts which became active Jan. 1, and another recently adopted for Hudson County, N. J.—a part of the metropolitan district. Enforcement of the New York City ordinances has become more active within the past few months, and proposals are now under consideration to extend its scope to cover fly ash.

Stevens Institute of Technology has established a chair for smoke abatement research to which it has called Colonel E. H. Whitlock, formerly Smoke Commissioner of Cleveland.

The United States Bureau of Mines has renewed its activity in smoke abatement work by circulating the A.S.M.E. proposed model ordinance of 1924, with a view to securing suggestions for bringing it up to date.

Conscious of the renewed interest and in response to a number of direct requests, the Fuels Division of the A.S.M.E. is planning a definite program with respect to smoke and fly ash abatement which will include the correlation of research, codification of ordinances, establishment of a clearing house for information and assistance to local agencies. An entire session at the coming National Fuels Meeting in Chicago will be devoted to the subject.

Although many power companies and some of the larger industrials have installed equipment designed to arrest stack dust, it cannot be said that the problem has been completely solved. Progress has centainly been made and numerous independent investigations are still proceeding. The need for correlation of this work and further research is apparent. There is also need of an acceptable method for measuring the amount of fly ash in flue gases. It is useless otherwise to prescribe prohibited quantities in ordinances.

Ameliorating Factors

A REDUCTION in the quantity of fly ash is said to result from vertical firing of pulverized coal in a slagging furnace. The increasing availability of natural gas will be of far-reaching benefit to industrial and domestic boiler plants, as its use practically solves the smoke and dust problem.

Abroad, permission to erect the Battersea station was contingent upon elimination of the stack nuisance. After much experimental work an elaborate system of flue gas scrubbing was adopted (see *Power* Nov. 4 and Dec. 30, 1930) which it is confidently believed will accomplish the purpose. The Barton station at Manchester has been given two years in which to eliminate its stack nuisance or suffer the penalty of being shut down.

In Germany much attention is being devoted to the subject by the Federal Coal Council, which last summer sent a representative to the United States to study what is being done with the stack dust problem. High stacks have been generally used in Germany to diffuse the discharge. Three different systems of dust catchers were tried at Klingenberg station in Berlin, namely, electric precipitation, cyclones and washers. It is understood that the first was adopted.

In the enforcement of existing laws in the United States it is apparent that those cities resorting only to the fining of offenders are making little progress; whereas those staffed to offer engineering advice and assist offenders in rectifying their troubles are making substantial progress in their smoke problems. One difficulty that has beset many smoke inspection departments in the past was the lack of continuous funds to carry on the work. This is gradually being corrected.

An Engineering Problem

WITH the added interest in problems of smoke and flue dust elimination, it should be definitely pointed out that there is no one standard or universal method for its accomplishment. The smoke and flue dust resulting from different plants will vary with their design, locality, the fuel used, and method of operation. The proper treatment of each case is distinctly an engineering problem, upon which must be brought to bear a thorough and practical knowledge of combustion. With the growing interest in the subject throughout the country there is danger that these qualifications may not be given the full weight to which they are entitled. Experienced smoke commissioners are not sufficient in number to meet the demands. There are, however, many engineers with the technical and personal qualifications to fill all requirements, with short training. Sources of advice and assistance of the highest order are available for those who wish actively to follow the work, and it is hoped that they will be utilized. The mistake which surely would result from a failure of interested communities to appreciate the qualifications necessary in smoke commissioners would seriously delay the progress and work a decided injustice upon the owners of plants, who will be generally found willing to co-operate with enforcement agencies under proper conditions.

That there is greater atmospheric pollution today than existed ten years ago is a logical result of the ever-increasing concentrations of industry and of population with their attendant needs for heat, light, power and transportation. This means the expenditure of more energy, which, in turn, must be supplied largely by fuel. The problem is to so control this pollution as to keep it from becoming obnoxious or a hazard to health and property.

Societies, Research, Standards Grow Internationally

AS IN 1929 the outstanding feature of society activities, research and standardization in 1930 was their growth in international character. A new mark was set in the size and fruitfulness of world-wide engineering meetings, the results of research were more widely exchanged, new international standards were established and more personal contacts were made between engineers of all nations.

By far the most important event of the year was the second plenary session of the World Power Conference held in Berlin, Germany, last June. There more than 4,000 leaders of science, engineering, industry and finance gathered to participate in the greatest meeting in engineering history. Economic in character and vast in scope, the thought and ideas contained in the 450 papers submitted contributed definitely to our progress.

Other engineering meetings of world-wide scope were the seventh plenary session of the International Electrotechnical Commission in Scandinavia during June and July, the International Steam Tables Meeting at Berlin in June and the International Congress of Applied Mechanics at Stockholm, Sweden, in August.

In the United States three engineering societies celebrated their 50th anniversaries—the American Society of Mechanical Engineers in April, the Michigan Engineering Society in January and the Cleveland Engineering Society in March. The A.S.M.E. celebration was the occasion for the publication of 50-year progress reports of international scope on all branches of mechanical engineering and the presentation of anniversary medals to world engineering figures.

Research

MANY ADDITIONS to research facilities were inaugurated or completed during 1930. The Packard Laboratory at Lehigh University, in Bethlehem, Pa., was opened; construction was started on a new industrial research laboratory at the Mellon Institute in Pittsburgh; and following the appropriation of $350,000 by Congress plans were drawn for a national hydraulic laboratory at the Bureau of Standards. In industry the Westinghouse Electric & Manufacturing Company announced the allotment of $1,500,000 for the erection of a central engineering laboratory and an addition to the present direct-current laboratory, both in East Pittsburgh; the General Electric Company started construction of a "blue-sky" laboratory at Pittsfield, Mass., for the investigation of lightning, and the A. O. Smith Corporation of Milwaukee made rapid progress in the erection of a large laboratory.

Steam-table research was given usable formulation during 1930 in the new Keenan steam tables published by the A.S.M.E. These tables, notable for the reliability of their data and for the convenient form in which they are presented, give the properties of superheated steam up to the critical point and a temperature of 1,000 deg. F. At the international conference of steam table specialists, further modifications were made in the standard "skeleton table" of values and tolerances.

Under the auspices of the A.S.M.E. and A.S.T.M. joint research committee, studies of the high-temperature mechanical properties of cast and wrought carbon steels and high nickel-chromium steels were inaugurated. This committee also sponsored a comprehensive symposium, which will be held in 1931, to bring out the present high-temperature needs for metals in industry.

A preliminary study was made by the Brooklyn Edison Company of the effect of air and turbulence on condenser-tube deterioration, the results of which led to the formulation of a wider investigation to include representative operating conditions throughout the power industry. At the University of Illinois a satisfactory laboratory method was developed for testing resistance of refractories to slag action and thus predict their service value. Both investigations were sponsored by the A.S.M.E.

Standardization

CONSIDERABLE PROGRESS in standardization was made during 1930. Due to the rapid growth of industrial standardization, finances of the American Standards Association were underwritten for a period of three years by a large group of industrial organizations. As a result of this endowment, which permits of $150,000 annually, the association was able to extend its activities to practically all industries. In the power field it started work on the establishment of a standard for vacuum and pressure gages, approved safety codes for the installation of pulverized-fuel systems and the operation of refrigeration equipment and adopted standards for coal analysis.

Other standardization activities included revisions by the A.S.T.M. of specifications for iron and steel used in boiler tubes, the adoption by the A.S.H.V.E. of a code for rating heating boilers, and the completion by the A.S.M.E. of standards for 25- and 800-lb. hydraulic cast-iron pipe flanges and fittings, and heat and thermodynamic symbols. In addition a proposed standard for steel-base fittings for 250, 400, 600 and 900 lb. was completed by the A.S.M.E.

During the year three of the original A.S.M.E. Power Test Codes were completely revised in the light of current practice. These were the code on general instructions and the test codes for stationary steam-generating units and internal-combustion engines. Two new test codes for liquid fuels and atmospheric water-cooling equipment were completed, and considerable progress was made on the test code for centrifugal and turbine compressors and blowers. Final revision is now under way of the test code for complete steam-electric power plants. Standard specifications, ratings and acceptance tests for steam turbines and boilers were formulated and approved by the I.E.C. at its meeting in Scandinavia.

Progress was reported by the American Uniform Boiler Law Society in the adoption of the A.S.M.E. Boiler Code. The boiler code committee actively cooperated with the conference committee of the American Welding Society; and proposed specifications for the fusion welding of drums for power boilers were formulated.

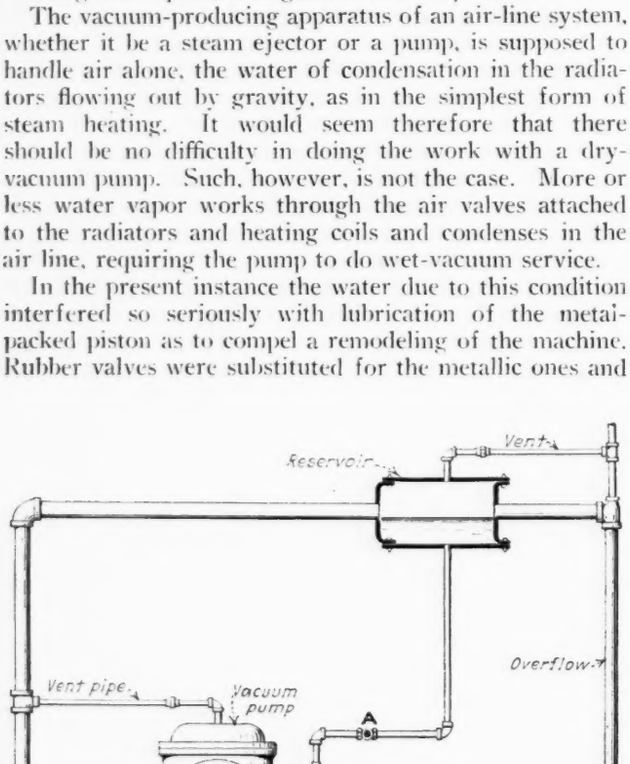
...RIGHT OUT OF THE PLANT...

Vacuum Pump on Air-Line Heating System

INSTEAD of installing a steam-operated ejector for use with an air-line vacuum system of heating containing 25,000 sq.ft. of direct radiation, the engineer decided to put in a motor-driven reciprocating pump. The pump he selected was designed for dry-vacuum service, having brass suction and discharge valves and a piston fitted with cast-iron snap rings. The piston's diameter was 4 in. and its stroke 6 in. The crankshaft, running 100 r.p.m., was geared to a 1-hp. motor.

The vacuum-producing apparatus of an air-line system, whether it be a steam ejector or a pump, is supposed to handle air alone, the water of condensation in the radiators flowing out by gravity, as in the simplest form of steam heating. It would seem therefore that there should be no difficulty in doing the work with a dry-vacuum pump. Such, however, is not the case. More or less water vapor works through the air valves attached to the radiators and heating coils and condenses in the air line, requiring the pump to do wet-vacuum service.

In the present instance the water due to this condition interfered so seriously with lubrication of the metal-packed piston as to compel a remodeling of the machine. Rubber valves were substituted for the metallic ones and



Water seal and vents for wet-vacuum pump

the snap-ring piston was replaced by one fitted with fibrous packing.

The pump gave a displacement of about 0.35 cu.ft. per 1,000 sq.ft. of direct radiation. This rating insured efficient working of the plant, but it is not to be regarded as arbitrary for any system of the size under consideration.

To give the valves tight contact and to fill up the clearance spaces in a wet-vacuum pump, a water seal is necessary. The apparatus erected for that purpose in this instance is shown in the accompanying illustration. The stopcock *A* is opened just enough to let a small trickle of water pass through from the elevated reservoir into the suction line. This sealing water returns to the reservoir through the discharge pipe, and any extra water from condensation of vapor in the air line overflows into the sewer.

The discharge as well as the suction connection being on the side of the pump, instead of on the valve-chamber hood, makes for convenience in getting at the valves for inspection or renewal. This construction, however, invites air or water vapor to collect in the hood, thus diminishing the pump's capacity. In the present instance the engineer avoided this difficulty by running a small vent pipe from the central point of the hood to the discharge pipe.

A. J. DIXON.

St. Louis, Mo.

Extracting Heat and Power From Ice Water

REVIEWING the results of the recent tests carried out at Matanzas (Cuba) by Professor Claude, I consider that one ought to hold in mind as the interesting result the fact that a turbine was able to operate with the small difference of 18 deg. F.; but it does not appear that the scheme can be realized to advantage from an economical standpoint, owing to the necessity of installing upon "floating islands," in the middle of the ocean, plants of large size.

Much more interesting, appears to be the project for the use of unfrozen waters in the Arctic, as given by Dr. Barjot in the March 11 number. In this, in fact, the difference of temperature is much greater than that employed by Professor Claude, and it can be used at a distance of a few feet, which leads to the hope for an inexpensive plant without any complicated construction. But especially the scheme points to the possibility of the industrial use of the Arctic regions, and this, from an economic standpoint, may have incalculable consequences.

It appears, in fact, that the high winter temperature of the Arctic water constitutes the most remarkable natural difference of temperature on the whole surface of the globe. The water of a lake under the pack is automatically inclosed as in an immense heat-insulated reservoir, and the whole may be compared to an enormous heat accumulator.

It should be remarked that the formation of lighter ice on the surface of the liquid is a fortunate anomaly

in the laws of solidification. Who can deny that it was not foreordained, since it permits the subjacent water to retain all its heat during the severe arctic winter and thus to preserve the life of the fish.

On the other hand, due to the ingenious project of Dr. Barjot, this stored supply of available heat will permit men to live and prosper in regions hitherto unsuitable for civilization.

Much publicity and much expense have been undertaken for polar explorations, the result of which has been some observations which have no doubt a certain interest. In comparison, the Barjot plan, as yet but little known to the public, may hold for mankind a much greater value.

Brockville, Ont. HENRY MASSON.

Carbon Monoxide in Diesel Engine Crankcases

IN A RECENT number of *Power* a contributor drew attention to the fact that he had not noticed any warnings in the technical press relative to the danger of workmen entering the crankcases of diesel engines immediately after the doors had been removed following a run. He expressed surprise at this omission, but I am wondering if he has ever experienced a case where a workman has been overcome by crankcase gases on a diesel engine.

Investigations of the composition of the exhaust gases of diesel engines show that there is no carbon monoxide or ammonia gas present. In support of this view reference may be made to *Mechanical Engineering,* Vol. 51, and to *Western Machinery*, where an abstract is given of a paper by Professor Meyer of Technical College of Delft, Holland.

If no carbon monoxide comes from the exhaust gases or products of combustion, and none certainly comes from the lubricating oil, it would appear that danger from this source is nil. W. S. BROWN.

Auburn, N. Y.

Pointers on the Care of Commutators

MANY operating engineers make a practice of lubricating the surfaces of commutators on direct-current generators and motors with wads of cotton waste saturated with engine oil or vaseline. This is done to reduce incipient sparking of the brushes and to keep them from chattering. But the relief is only temporary and must be repeated from time to time. Such lubrication is objectionable because it tends to produce gummy accumulations around the brushes and between the commutator segments. It is unnecessary if the commutators and brushes are kept in perfect condition. The brushes themselves will supply enough lubrication, especially if they are of graphite, provided the commutator be kept clean and smoothly polished. Where the commutator is kept truly cylindrical and even from end to end, and is free from abrasions, a single set of brushes may last from two to four years. The same set of brushes on a neglected commutator might not last six months. To keep a well-conditioned commutator cleaned and polished while in service, it is only necessary to occasionally hold a pad of dry canvas against the revolving surface.

The roundabout spacing of commutator brushes should be symmetrical. If the spacing is irregular—if two contiguous rows of brushes are closer to each other than are two other contiguous rows—the armature circuits will be unbalanced and heating of the commutator and sparking of the brushes will result. The brushes should be staggered, that is, they should be so distributed that the commutator will be subjected to their wear from end to end.

The commutators on some older machines often show a series of narrow ridges, as a result of corresponding brushes in the different rows being aligned exactly in the same circles of contact.

When it is necessary to put new brushes in the holders, they should be fitted to the curvature of the commutator. It is not good practice to leave the brushes flat-ended and depend upon the wear of service to give them the necessary concavity. The contact end of a brush may be given the proper shape by inserting a strip of moderately coarse sandpaper between the brush and commutator and pulling the strip in the direction of the commutator's rotation. This operation should be repeated until enough of the brush material has been ground off to give the needed curvature. The strip of sandpaper should not be pulled back and forth, because in doing so the edges of the brush may be rounded off.

Sandpapering the commutator while the generator is running is practiced by many operating men. Generally, the idea of such sandpapering is to reduce sparking. The sparking may thus be abated for a time, but it is likely to recur later on in a manner more acute than before. The particles of copper and grit liberated during the sanding process will tend to lodge beneath the brushes; and the smoothed-up commutator surface will be roughened once more, perhaps worse than it was in the first place. When it is necessary to sandpaper a commutator, the generator should be disconnected from the line and the brushes raised. And when the job is done, all traces of copper dust and fine sand should be blown and wiped away.

The mica insulation between the commutator segments should be undercut, because if it projects but slightly the brushes will be cut away in a short time. But discretion must be exercised in doing the undercutting; if too much of the mica is removed, cavities will be left for accumulations of copper and carbon dust, mixed, perhaps, with grease deposited by an oily vapor in the surrounding atmosphere. Thus the commutator bars may become short-circuited. In any event, serious sparking is sure to result from such deposits between the segments.

Chicago, Ill. D. J. ALLISON.

Flexible Wire Best for Shunt-Field Connections in D.-C. Machines

NUMEROUS cases of trouble have been encountered on direct-current machines from the shunt-field leads breaking or burning open. Most of this trouble is caused by having solid wire in the leads connecting the field coils with the outside terminals. The solid wire is too rigid to withstand vibration, and finally breaks near the point of connection.

To overcome this difficulty I have used a flexible wire twice the size of the original lead. This eliminates all trouble from broken connections.

Butte, Mont. RALPH E. MACKAY.

WHAT'S NEW IN PLANT EQUIPMENT

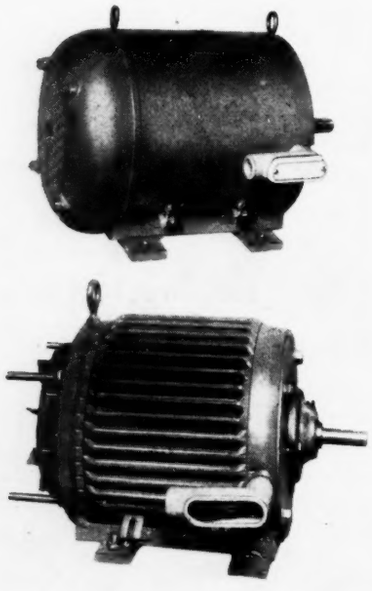
HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Totally Inclosed Fan-Cooled Induction Motor

ARC-WELDED steel construction, double-sealed ball bearings, and a removable cover which facilitates cleaning of the large radiating surface are features of a new line of totally inclosed fan-cooled induction motors put out by the Lincoln Electric Company, Cleveland, Ohio.

The large radiating surface is obtained by complete inclosure of sides of the motor with a deeply corrugated sheet of corrosion-resisting metal. The air imprisoned within the sealed frame is constantly circulated by a fan arc-welded to the rotor. This fan drives the heated air within the motor to continuous contact with the corrugated cooling surface. Outside air to absorb the heat from the radiating surface is forced across the exterior of the corrugated surface by a fan attached to the motor shaft. The corrugated cooling surface is easily accessible for cleaning by removing the one-piece cover. To insure complete inclosure of the motor the rolled steel end plates are machined to accurately fit the end rings of the motor frame. The ball bearings that inclose the shaft opening in the end plates are sealed both inside and outside.

This motor has the same mounting dimensions as standard, open-type, horizontal machines of equal rating. It is available in sizes from 1 to 50 horsepower.



Motor with cover on and also with cover removed for cleaning the corrugated radiating surface

Shaker Conveyor Drive

SIMPLICITY and compactness are features of the shaker conveyor drive designated C20 recently developed by the Conveyor Sales Company, Inc., 299 Broadway, New York City. Over-all dimensions are, height, $24\frac{3}{4}$ in.; width, $84\frac{1}{2}$ in., plus from $20\frac{7}{8}$ to 35-5/6 in. for the motor; and length, 44 inches.

The mechanism consists of a gear train and crossarm which convert the rotary motion of the motor into reciprocating motion of a crosshead connected to the conveyor trough. The mechanism is totally inclosed in a heavy cast-steel case, which also serves as an oil reservoir. The driving motor is rated at 20 hp. and automatic remote control with time-limit acceleration and full protection against overload and undervoltage is provided. The gears are made from heat-treated cast steel, with stub-cut teeth, and all shafts are mounted in anti-friction bearings. Lubrication of the various bearings is provided by an oil pump located in the case and driven by an eccentric on the primary drive shaft. The maximum length of the stroke is 11 in., and fourteen different strokes, between 11 in. and zero, are available.

Shaker conveyor drive with direct-connected motor

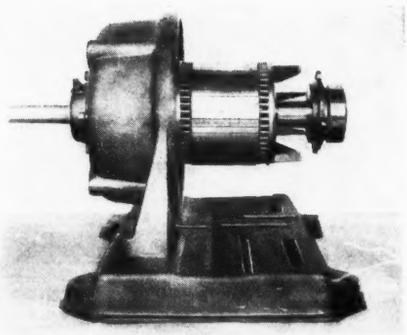
Unit-Type Induction Motor

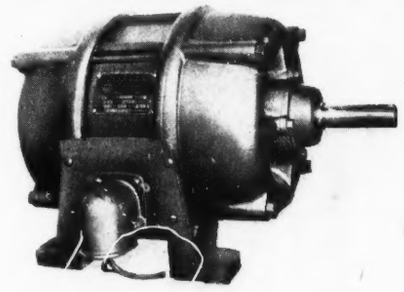
A RADICAL DEPARTURE in motor design is embodied in a new line of motors designated "unit type," in sizes from $\frac{1}{2}$ to 200 hp., put out by the Ideal Electric & Manufacturing Company, Mansfield, Ohio.

As will be apparent from the upper view in the illustration, the motor feet are on the bearing brackets instead of the stator, as is the usual practice. With this construction all load shocks and strains are carried directly to the motor support. This construction also facilitates inspection and cleaning, for when the front end bracket and stator are removed the pulley end bearing bracket remaining bolted to the base will still support the rotor and gear, pulley, or other connection to the driven unit.

The motors are built with standardized units (rotors and stators) which are interchangeable for all types. Thus standard horizontal motors, shell-type motors, flange-type motors, vertical motors, special applications of "built-in" motors requiring only the active elements, etc., all take the same rotors and stators. This applies not only to squirrel-cage induction motors but also to slip-ring induction motors and direct-current motors.

Interchangeable ball, roller or sleeve anti-friction bearings are supplied as standard. The ball and roller bearings are of the cartridge type, so constructed that the motor can be





Unit-Type motor with motor feet on the bearing brackets

taken down without dust or dirt entering the bearing.

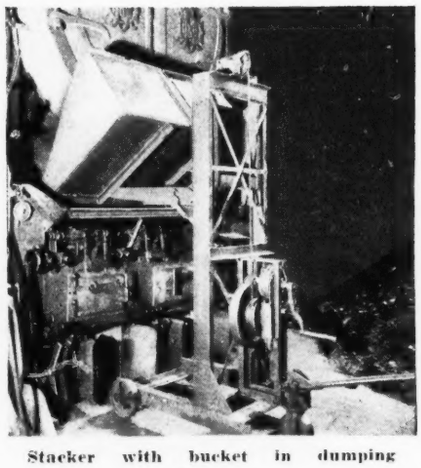
The sleeve bearing housings are of a new design that can be rotated for wall or ceiling mounting without removing the bearing brackets, and these sleeve bearings can also be replaced without removing the bearing brackets or dismantling the motor.

Stacker Elevates and Dumps Coal Into Stoker Hopper

IN MANY plants where hand-operated and semi-automatic mechanical stokers are used no overhead coal bunkers or other mechanical equipment is installed to transfer the coal from point of unloading to the stoker hopper.

With a view to lessening the manual labor involved in getting the coal into a hopper where no mechanical equipment is provided the Lewis-Shepard Company, Watertown, Mass., has brought out the stacker shown.

Used as a truck, the stacker is drawn from the coal pile over a scale for weighing and then to a position in front of the stoker. In the unit shown the lifting and dumping are done by a hand-power winch. Motor-operated units are also available.

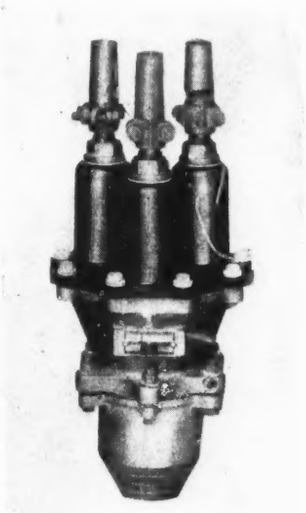


Stacker with bucket in dumping position

Three-Conductor Cable Terminator

THE Delta-Star Electric Company, Chicago, Ill., has recently introduced a new line of three-conductor terminators for either compound or oil filling and designed to be vacuum-tight and to withstand a hot oil pressure of 50 lb. per square inch with oil at 180 degrees.

The main body is of aluminum alloy, and the top element is made of



Terminator for 7,500-volt cables

high electrical strength molded insulation mechanically stronger than porcelain. The terminators are for voltages up to and including 7,500, and for ampere capacities up to 500.

Explosion-Proof Direct-Current Motor

AN EXPLOSION-PROOF direct-current motor recently introduced by the Reliance Electric & Engineering Company, 1042 Ivanhoe Road, Cleveland, Ohio, is of unusually heavy construction and tightly sealed against leakage of air or gas. It is pointed out by the manufacturer that

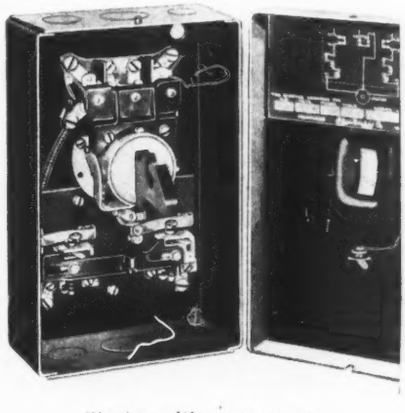
Motor designed for use in explosive atmosphere

the motor is so constructed that even if an explosive mixture of gas and air should leak inside and explode, the motor will withstand the shock and not communicate sparks and flame to the outer air.

Special attention has been given to sealing the motor leads where they come through the housing, and the shaft bearings.

Hand-Operated A.-C. Starter With Overload Breakers

THE NEW hand-operated alternating-current starting switch with overload breakers (Bulletin 609) put out by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis., handles all motors up to 3 hp., 110 volt, 5 hp. 220 volt, 7½ hp., 440-550 volt. Overload breakers operating on the soldered ratchet principle eliminate maintenance of thermal plugs and fuses. They will interrupt any overload and are reset with a lever without opening the switch cover. The starting lever has a safety interlock which prevents the cover from being removed unless the lever is in "off" position. It can be also locked in open position if required.



Starter with cover open

NEWS of the FIELD

Utilities Plan Expenditure of $307,776,000 For New Steam and Hydro Plants in 1931

Despite business depression budget compares favorably with $325,296,000 for 1930

EXPENDITURES by light and power utilities for the construction and equipment of new generating facilities during 1931 will total $307,776,000, according to the best estimates available at the time of going to press. When the effect of the current business depression is taken into consideration, this figure compares favorably with expenditures in 1930 of $325,296,000 for new generating plant and equipment.

Including proposed expenditures for municipal, local and all other light and power properties, the 1931 budget of $307,776,000 allots $202,395,000 for the construction and equipment of steam generating stations and $105,381,000 for hydro-electric plants. Comparative figures for 1930 are $207,901,000 for steam plants and $117,395,000 for water-power projects.

Of the total amounts allotted for steam and hydro plant construction and equipment during 1931, the largest expenditures will be made by power utilities in the North Central section of the country. There, $111,591,000 has been allotted for new plant facilities, with $97,147,000 to be spent on the construction and equipment of fuel-burning stations and $14,444,000 on water-power projects. Utilities in the Eastern section of the country come next with a total of $85,344,000 appropriated for generating facilities, $54,945,000 for steam and $30,399,000 for hydro. Third and fourth are the Southern and Western sections of the country, with allotments of $60,505,000 and $50,333,000, respectively. In the South utilities expect to spend $33,264,000 on steam stations and $27,241,000 on hydro plants, while Western utilities have appropriated $17,037,000 for steam plants and $33,296,000 for water-power projects.

Some of the more important 1931 construction expenditures—which include total allotments for new steam and hydro plants, transmission, substations and distribution and miscellaneous items—already announced by individual companies and groups of utilities include $28,000,000 by the Southern California Edison Company; $24,445,000 by the National Electric Power Company system; $13,000,000 by the Detroit Edison Company; $12,000,000 by the New England Power Association; $10,100,000 by the Edison Electric Illuminating Company of Boston; $10,310,000 by the Puget Sound Power & Light Company, and $3,300,000 by the Public Service Company of Colorado. The largest item in the budget of the Puget Sound Power & Light Company, $6,755,000, will be spent for carrying on work at the company's Rock Island hydro-electric development.

During the period from 1920 to 1930 the light and power utilities spent a total of $6,007,326,000 for new plant and equipment, and it is estimated that from 1930 to 1940 similar expenditures will amount to $11,400,000,000. The investment per unit of generating capacity for the past decade has decreased slightly and is now about $325. The per cent of total time generating equipment is used has increased from 20 to 30 in the same period, and the kilowatt-hours generated per unit of capacity has increased from about 1,100 to 2,700 in the ten years. The revenue and investment values per customer have remained about stationary, the present values being about $500 for investment and $100 for revenue. These figures show that there has been a fairly uniform earnings basis over the decade despite enormous expenditures and lowered rates, and this has been made possible by greater hours' use of equipment, decreased unit costs of equipment and better operating performance.

POWER was founded in November, 1884, by E. P. Harris and H. M. Sweetland. With it was incorporated "Steam," which had been started by N. Hawkins in Chicago two years earlier.

Ownership later passed to H. M. Sweetland and James H. McGraw; then to John A. Hill; and with the consolidation of the Hill and the McGraw publishing companies in 1917 it became the property of the McGraw-Hill Publishing Company.

Robert Grimshaw was the first editor of POWER. *Subsequent editors for short periods were George L. Fowler, A. D. Risteen and Franklin VanWinkle. F. R. Low became editor in 1888.*

The present staff is Ely C. Hutchinson, editor; F. R. Low, editor emeritus; A. D. Blake, managing editor; P. W. Swain, Thomas Wilson, F. A. Annett and L. H. Morrison, associate editors; and A. L. Cole, R. B. Purdy, H. R. Clark and L. E. Driscoll, assistant editors.

Engineers Organize for Unemployment Relief

ANSWERING the call of Col. Arthur Woods, chairman of President Hoover's Emergency Employment Committee, for aid in the present unemployment crisis, the engineering profession of the country, through the American Engineering Council, has undertaken to disclose the facts of unemployment and of relief effort, temporary and permanent, throughout American industry. "Regularization" of industry will be the keynote of the investigation, which will be directed by a recently appointed committee of the American Society of Mechanical Engineers.

Heading the committee is Ralph E. Flanders, a vice-president of the society, and manager of the Jones & Lamson Machine Company. Other members are: Dexter S. Kimball, dean of the College of Engineering in Cornell University; Ely C. Hutchinson, editor of *Power;* Joseph W. Roe, professor of industrial engineering in New York University; Col. C. H. Crawford, contracting engineer of New York; Col. W. A. Starrett, vice-president of Starrett Bros. & Eken, Inc. Ex-officio members are the president of the society, Roy V. Wright, and Calvin W. Rice, secretary of the Society.

More than 100 subcommittees will be appointed, representing local sections of the A.S.M.E. and A.I.E.E. The information gathered by these committees will be turned over to the council for submission to Colonel Woods. Work will begin at once, and results upon which Colonel Woods can act in furtherance of the federal employment program are expected to be available this month. The working committees will canvass all manufacturing com-

panies in the United States employing 100 or more persons, not including public utilities. Chambers of commerce, boards of trade, and other organizations will be asked to aid.

To ascertain the extent and success of programs to regularize business will be a chief aim. Processes concerning which knowledge will be sought embrace the leveling out of sales, production, and labor turnover, and the diversification of product. The engineers will inquire into the difficulties met with by industries in sales control, in product control and operation, and in co-operation activities. The engineers will try to find out whether the procedure which works in one plant would also work in other plants in the same industry, and whether it would apply to other types of business.

The quest will extend to industry's plans for 1931, particularly as they affect expansion and contraction of operation. Enlightenment as to employment guarantees and relief measures of all kinds is another objective. Much supplementary information, it is anticipated, will also be collected.

Ohio Saves $600,000 on State Power Plants

APPROXIMATELY $600,000 was saved to Ohio taxpayers during 1930 on the state's steam, electrical and water services in the state's 41 institutional power plants, according to the yearly report of H. W. Brooks, consulting engineer of Fremont and New York, issued Dec. 26 by the State Department of Finance. The saving was accomplished mainly by the centralization of all state power plant engineering under one responsible head, and the reorganization of the plants to produce power and steam in as cheap and efficient manner as possible.

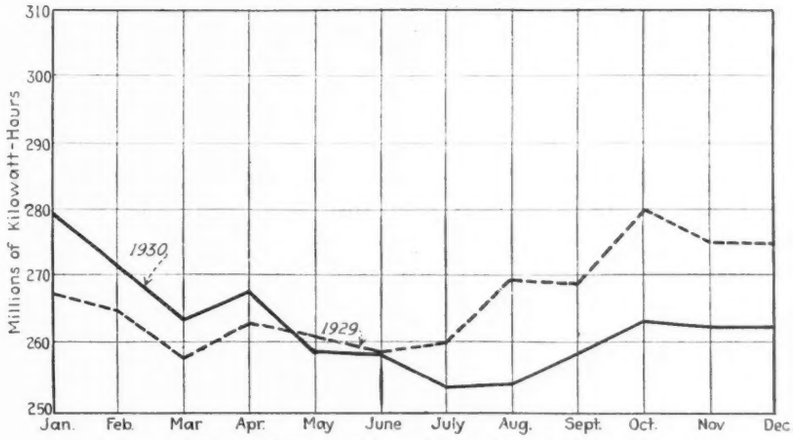
A large portion of the total saving was effected by more efficient utilization of the economical sizes and cheaper grades of coal. These finer sizes, unburnable in domestic furnaces and difficult of sale by the Ohio mining industry, are the cheapest coals obtainable for power plants, and with proper firing equipment have proved most efficient.

Coal tests were conducted in the majority of the plants to determine the most efficient fuels. The competitive tests proved that Ohio coal made the cheapest steam and provision has been made for the conversion of all state plants to the use of Ohio coal. In many cases the fuel bills were cut from 20 to 30 per cent, a saving of over $100,000. Over $70,000 saving was effected in lower freight rates through using the coal from the nearest of Ohio's fields.

Through similar methods the federal government saves more than $1,000,000 yearly in federal institutional plants. New York, Maryland and Connecticut are investigating the plan preparatory to its initiation in those states. It is conservatively estimated that a total of $25,000,000 could be saved to taxpayers annually if other states adopt the plan.

In Ohio the reorganization was effected without the discharge of a single employee and more than 100 additional men were employed in various phases of the coal industry through the added stimulation during the depression.

Utility Power Production for 1930 1.5 Per Cent Below 1929



Average daily production (November and December estimated)

TOTAL PRODUCTION of electric energy by public utility power plants in the United States during 1930 amounted to 95,891,000,000 kw.-hr., according to the best estimates available. Compared with the 1929 output of 97,352,000,000 kw.-hr., this shows a decrease of approximately 1.5 per cent. As compared with the total for 1928, however, the 1930 output shows a gain of more than 9 per cent.

As shown by the curve of average daily production, the output during the first four months of 1930 maintained gains of from 1 to 5 per cent over the output of the corresponding months of 1929. From May on the 1930 output fell below that of 1929, reaching a maximum decline of 6.3 per cent in October, according to the latest figures of the Geological Survey of the Department of the Interior.

Production of electricity by water power continued to decrease during 1930 due to the unusual drought conditions prevalent in most sections of the country. It is estimated that 33 per cent of the total output for the year was produced by hydro-electric plants, as compared with 36 per cent in 1929.

Indications are, however, that the gross and net earnings of public utilities reached a record high point in 1930.

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Wyman Hydro Station Placed in Operation

THE FIRST GENERATING UNIT at Wyman Dam was placed in service at Bingham, Me., Dec. 29, following preliminary testing which has extended over a period of ten days. Water in the twelve-mile lake created back of the 2,800-ft. dam is over 25 ft. above the intake section. The second unit is now being installed to be followed by a third, which will make possible the generation of 100,000 hp. of electric energy. Construction of this large plant is part of a regional industrialization program being executed by the New England Public Service Company, through its operating subsidiary, Central Maine Power Company.

New Hell Gate Boilers Placed in Service

TWO NEW BOILER UNITS, which, with the building in which they are housed, coal pulverizing mills, superheaters, economizers, air heaters and other auxiliaries, were built at a cost of $5,000,000, have just been put into service by the United Electric Light & Power Company at its Hell Gate generating station.

These two boilers, which were manufactured by the Babcock & Wilcox Company, supply steam to drive one of the 160,000-kw. turbine-generators installed some time ago. Each boiler has a nominal rating of 800,000 lb. of steam per hour at a temperature of 725 deg. F. and 275 lb. pressure. They have many new features of design. All fans, mills, feeders and dampers are controlled from a central operating board so centralizing the control to an extent never before attempted. At maximum capacity there is burned in the furnace for each boiler about 100,000 lb. of coal per hour and the output exceeds a million pounds of steam per hour. The furnace ash is discharged periodically in molten form.

Review of Conditions in Business and Industry Points to Upturn in 1931

ANALYSES of conditions existing during 1930 and forecasts for 1931 by competent observers in business and industry at large indicate the beginning of business recovery during 1931. Some believe this will come about gradually through the early months of the year, while others, feeling that the recovery period will be nearly equal to the recession period, do not anticipate normal conditions until later in the year. The following observations have been taken from reports of the various fields:

Of the electrical industry, Gerard Swope, president of the General Electric Company, says, "We, in the electrical industry, possibly have had more to be thankful for during the past year than those in many other lines of endeavor and this may also be true of what the future holds for us. New methods in industry, with electricity as their base, are being continually introduced; new uses are constantly being found for electrical apparatus and appliances in the home and new devices are being developed to meet these needs. . . . We expect this course to continue, and therefore look forward with confidence, believing that the electrical manufacturing business, as a whole, in the new year should surely be no worse and possibly somewhat better than in 1930."

A heavy volume of public works was the pronounced characteristic of 1930 in the field of civil engineering construction. House building continued in a severe depression, and went even considerably lower than in 1929, itself a low year. Since house-building picked up somewhat toward the close of the year, greater activity may be looked for in 1931. In any event, the increase planned in public works over the large totals of 1929 and 1930 will put construction into a leading position of strength during the coming year.

Compared with results in 1929, the coal industry has suffered relatively little during the present year. Bituminous production to December 1, 1930, 421,898,000 net tons, was less than 13.2 per cent under the cumulative total for the corresponding period in 1929. Anthracite output for the first eleven months of the current year approximated 63,716,000 net tons, less than 4.2 per cent under 1929 figures for a similar period. With more than 80 per cent of the bituminous tonnage entering into the industrial stream, it is obvious that any early sharp upturn in production must wait upon a general revival in business.

With the majority of companies in the metal working and machine tool field, 1930 draws to a dull and gloomy close. The toboggan-like descent of every barometer for the industry from a moderate peak in March to a deep valley in August was followed by what gave promise of being steady recovery. Unfortunately, this recovery continued for only two months and was followed by a renewed decline which, at this writing, has reached an even deeper valley. Much change before the first of 1931 is unlikely.

Rate of mill operations in the textile manufacturing industry during 1930 was approximately 20 per cent lower than in 1929. This estimate is necessarily a rough one, owing to the difficulty of establishing a group average for an industry comprising so many branches.

The non-ferrous metal mining industries have shared in the industrial depression that has been characteristic of 1930, having been burdened with reduced consumption, excessive stock of metal, production greater than was required, and low prices, below the average cost of production in many instances. As the year closes, however, there are definite indications that an improvement has already set in which, if continued, as seems likely, may result in a normal amount of business and fair prices by the end of the coming year.

Production of chemicals in 1930, while smaller than in 1929, was on a relatively higher basis than manufacturing industry as a whole. To a certain extent, this was due to the replacement of foreign-made chemicals by domestic products. The outlook for chemicals over 1931 is so closely connected with the position of general industry that it can be said to depend on general conditions. Fairly definite estimates, however, may be made regarding the first quarter of the year. The industries about which expansion programs have been most definite include those which offer wide outlets for chemicals. Among these may be mentioned building, tire, automotive and steel. Dyeing and finishing of textiles also look more favorable than at the close of 1929.

Sales of radio receivers to the public during 1930 reached 3,500,000 sets, according to best estimates now available. Of this number approximately 2,750,000 were produced during the year 1930, the others being carry-over stock from the preceding year. Improvements in broadcasting conditions and increases in station power may be expected to open up new territories, and these, with the new industrial and business uses of sets now being developed, will, it is expected, restore 1931 volume to past prosperous levels.

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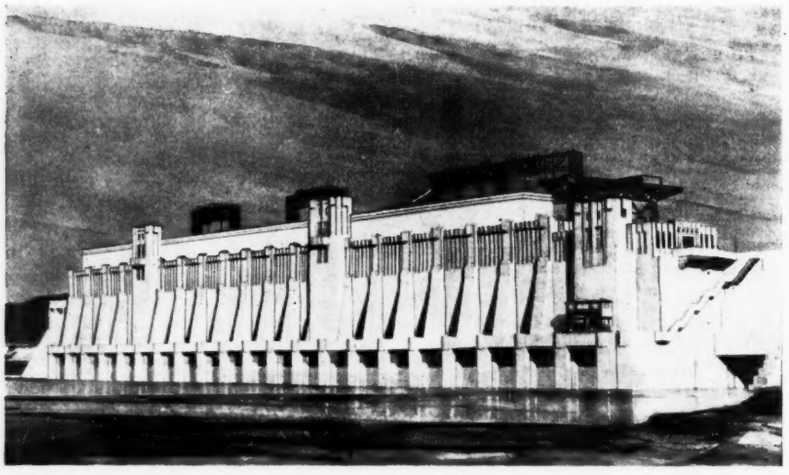
AS THE ARCHITECT SEES IT



The 880-ft. hydro-electric power station at Rock Island as it will appear when completed. The above picture is from an architect's drawing of the big plant on the Columbia River near Wenatchee, Wash., which will house generators for an ultimate production of 240,000 hp. of electric energy. It is now under construction for the Puget Sound Power & Light Company, and the first four units will be in service by August, 1932. The cost of the project when fully developed will be $28,000,000

Prime Movers Increased 23%, 1929 Census Shows

THE BUREAU OF THE CENSUS announced Dec. 31 that, according to a preliminary tabulation of the data collected in the census of manufactures taken in 1930, the total value of engines, turbines, and water wheels, and parts and attachments shipped or delivered in 1929 by establishments in the United States engaged primarily in the manufacture of such commodities amounted to $406,412,312, an increase of 23.3 per cent as compared with $329,576,820 reported for 1927, the last preceding census year.

In addition, engines, turbines, and water wheels, and parts and attachments are manufactured to a large

extent as secondary products by establishments engaged primarily in other lines of manufacture. The value of such commodities thus produced outside the industry proper in 1927 was $30,029,853, an amount equal to 9.1 per cent of the total value of this class of products made within the industry. The corresponding value for 1929 has not yet been ascertained, but it will be given in the final report of the present census.

Total value of electrical machinery, apparatus, and supplies manufactured in 1929 by establishments in the United States for use primarily in the generation, transmission and utilization of electrical energy amounted to $2,323,597,927, an increase of 39.3 per cent as compared with $1,668,104,965 reported for 1927, the last preceding census year.

The total for 1929 is made up as follows: Insulated wire and cable, $296,858,831; motors, not including fan motors, $185,233,201; batteries, battery parts, and supplies, $145,207,574; industrial, commercial, and domestic apparatus and appliances, $100,698,743; incandescent lamps, $85,319,515; switchboards, circuit breakers, and switches, $79,424,219; transformers, induction voltage regulators, and current-limiting reactors, $78,114,532; generating apparatus and parts, $68,131,815; ignition apparatus for internal-combustion engines, $54,426,944; conduits and fittings, $46,915,073; wiring devices, $43,120,093; control apparatus, $42,451,032; measuring instruments, relays, and instrument transformers, $38,328,070; electrotherapeutic and electromedical apparatus, $19,957,011; fuses and fuse blocks, $13,420,285; electric fans, $11,560,642; miscellaneous electrical equipment, $936,059,847.

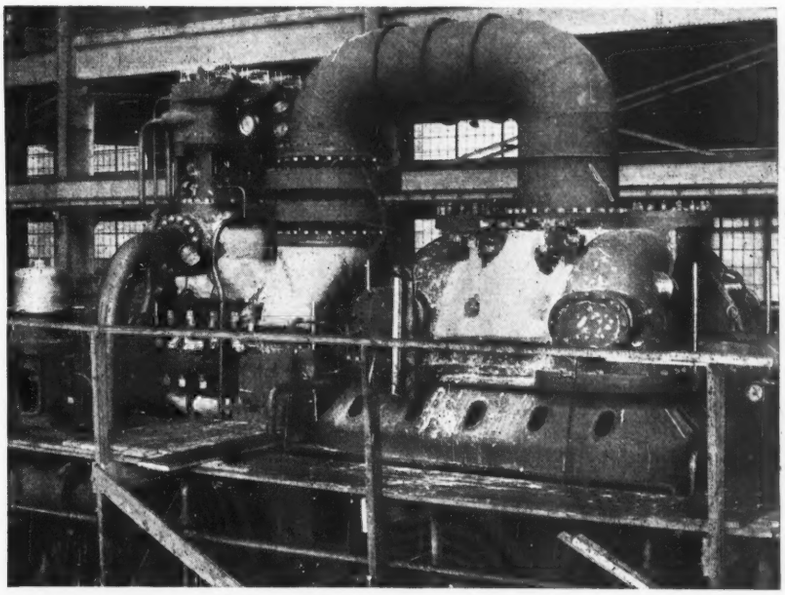
Permit Is Sought for 265,000-Hp. Project

PLANS for a 265,000-hp. water-power development on the Tennessee River near the Kentucky-Tennessee State line were discussed Dec. 27 with officials of the Federal Power Commission by Robert H. McNeill, general counsel of Southern Industries, Inc.

The corporation applied in September, 1928, for a preliminary permit for the project, which would cost perhaps $30,000,000. Action on the permit was held up pending the issuance of a certificate of convenience by the Tennessee Utility Commission and by the desire of the State of Kentucky to investigate the proposed project. While the power plant would be in Kentucky, the reservoir, being about 140 miles long, would pass into Tennessee.

Mr. McNeill made inquiry as to when the new commission would meet to take up its regular business, as he is interested in speeding up the issuance of the preliminary permit, it was stated.

LARGEST 3,600-R.P.M. CONDENSING UNIT



The largest 3,600-r.p.m. straight-condensing turbine ever built is shown on test. This turbine is of the compound-tandem type rated at 15,000 kw. capacity operating on steam of 450 lb. pressure and 750 deg. superheat and exhausting at 29 in. vacuum. It is one of two similar turbine-generator units which have been built by the Westinghouse Electric & Manufacturing Company for the new Bremo Bluffs Station of the Virginia Public Service Company

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National Chamber Adopts Water Power Policy

FIFTEEN PROPOSITIONS, constituting a national water-power policy, have been adopted by the organization membership of the Chamber of Commerce of the United States through a referendum. These proposals indicate, from the viewpoint of the membership of the chamber, the part that should be played by the state governments and the federal government in the regulation and control of water power development.

By an overwhelming majority the principle that the development and distribution of electric power should be left to private enterprise was approved and the recommendation that the Muscle Shoals project should be sold or leased, as is, on the best possible terms, was endorsed.

The preliminary canvass shows that 1147 commercial organizations and trade associations holding memberships in the chamber, cast approximately 3,000 votes in the referendum. The vote on the fifteen recommendations of the special committee which prepared the referendum report follows:

1. That federal and state appropriations should be increased for the collection and publication of data relating to water resources. For, 2,384; against, 451.

2. That the federal government should leave to the states all possible control over utilization of water resources within the states. For, 2,815½; against, 63½.

3. That each state should have an agency to promote and regulate development of its water resources. For, 2,739½; against, 129½.

4. That the states should use compacts among themselves for determination of their respective rights in boundary and interstate streams. For, 2,775½; against, 94½.

5. That through adequate appropriations, and through methods of appointment and compensation for members and staff, state commissions should be enable to discharge their duties with the greatest possible efficiency. For, 2,774; against, 83.

6. That state commissions should be authorized to initiate proceedings in which they may exercise their regulatory powers, including proceedings as to disparities in domestic rates. For, 2,669½; against, 172½.

7. That every effort should be made by regulatory bodies and utilities to reach by agreement the valuation to be placed on properties used for public service. For, 2808; against, 60.

8. That interstate power, so far as now incapable of regulation by states, should be regulated through concurrent action of state agencies made effective by the Federal Power Commission, and only in the event of failure of concurrence on the part of the state agencies should be regulated directly by the Federal Power Commission. For, 2,157; against, 679.

9. That municipally operated utilities should be subject to the same regulation as privately operated utilities. For, 2,596½; against 226½.

10. That the Federal Power Commission should avoid duplication by utilizing the field services of other agencies of the federal government. For, 2,810½; against, 46½.

11. That development and distribution of electric power is within the proper sphere of private enterprise. For, 2,713; against, 126.

12. That the federal government should leave the construction of dams and other structures and the generation of power to other agencies, except where they are an essential part of national or international projects that cannot be successfully carried out by other agencies. For, 2,704½; against, 139½.

13. That the federal government should always leave the transmission and distribution of power to other agencies. For, 2,617; against, 214.

14. That the state governments should leave development and distribution of power to utilities which they effectively regulate. For, 2,684½; against, 145½.

15. That the Muscle Shoals project should be sold or leased, as is, on the best possible terms. For, 2,640; against, 157.

News of Canada

Review of power developments completed during the past year

NEW WATER-POWER INSTALLATIONS brought into operation in Canada during 1930 aggregated 397,850 hp., bringing the total installation for the whole dominion to 6,125,000 hp., according to the annual statement issued by the Department of the Interior. Construction is active, also, on a number of undertakings throughout the country several of which are of outstanding magnitude and with the completion of these during the next two or three years more than 1,500,000 hp. will be added to the dominion's total. This large program of construction involved an expenditure of approximately $80,000,000 during 1930 and will involve as much as $300,000,000 during the next two or three years.

During the year the province of Ontario led in new installations placed in operation with a total of 136,000 hp., while other undertakings under way involve installations aggregating 442,000 hp. Hydro-electric construction activities were particularly active in widely separated parts of British Columbia, resulting in the addition of 71,000 hp. to the province's total. In addition, other projects were actively prosecuted involving initial installations totaling over 136,000 horsepower.

IN QUEBEC, new water-power installations placed in operation during 1930 totaled 123,000 hp., while there are developments of outstanding importance under active construction involving an initial installation of 805,000 hp. and final installed capacity of 2,013,000 hp. The plants under construction are practically all of large capacity including Beauharnois on the St. Lawrence, Rapide Blanc, on the St. Maurice, Chute-a-Caron on the Saguenay, and Chats Falls on the Ottawa. The Shawinigan Water & Power Company has completed a new storage reservoir of 33 billion cubic feet at Taureau Rapid on Mattawin River, an important tributary of the St. Maurice, and, to use the additional water thus provided has completed the installation of another 25,000-hp. unit at Grand'Mere, while one of 30,000 hp. is being added at La Gabelle to be ready next spring. The company has started the construction of a 240,000-hp. development at Rapide Blanc on the St. Maurice for which an initial installation of 160,000 hp. will be completed by the end of 1932.

The Alcoa Power Company, is completing the main dam and also the installation of its initial plant at Chute-a-Caron on the Saguenay River; this initial plant will have an installed capacity of 260,000 hp. in four units of 65,000 hp. each and will be in operation by February, 1931. The complete development of the Chute-a-Caron reach of the Saguenay River will be completed by the building of the 800,000-hp. Shipshaw plant, which will operate under a head of 205 ft., the water being supplied by a canal leading from the reservoir above Chute-a-Caron dam to the Shipshaw power house.

THE THREE PRINCIPAL EVENTS in Western Canada during the year were the completion of the first hydro-electric development in Saskatchewan at Island Falls on the Churchill River and the rapid prosecution of work on two large hydro-electric undertakings on the Winnipeg River in the province of Manitoba, one at the Seven Sisters site, where the Northwestern Power Company has a development under way which will ultimately comprise an installation of six units of 37,500 hp. each, and the other at Slave Falls, where the city of Winnipeg is engaged in constructing a plant designed for an ultimate capacity of eight 12,000-hp. units, two of which will comprise the initial installation.

In New Brunswick the St. John River Power Company commenced in October the addition of the fourth unit of 20,000 hp. in its hydro-electric development at Grand Falls on the St. John River. This was ready for operation before the end of the year and the plant is now completely installed with a total capacity of 80,000 horsepower.

PRESENT ANNIVERSARY MEDAL TO KIDDE

Walter Kidde & Company, Inc., and Walter Kidde Constructors, Inc., on Dec. 22 celebrated the 30th anniversary of the founding of these engineering businesses. After suitable ceremonies, the medal shown above was presented to Mr. Kidde by his associates. The designation "Engineer-Constructor" on the medal is a title which Mr. Kidde coined in 1889 when first starting in business for himself

Personals

FRANK W. PEEK, JR., has been appointed chief engineer of the Pittsfield works of the General Electric Company, effective January 1. Mr. Peek is at present chief engineer of the transformer engineering department of the company and is internationally known for his researches in high-voltage engineering and investigations of corona lightning phenomena, insulation and transmission practice. He is a native of California, was educated at Leland Stanford University and has been in the employ of the General Electric Company since 1905. His pioneering work in the high-voltage field has ranged widely from laboratory to line determinations of epochal importance.

FREDERICK E. MINDT has been appointed electrical engineer of the Public Service Commission of New Hampshire, succeeding Lyman E. Bigelow, resigned. Mr. Mindt is a native of Bath, Me., and his experience includes varied service with the Manchester Traction, Light & Power Company of New Hampshire, Amoskeag Manufacturing Company of Manchester, Westinghouse Electric & Manufacturing Company, New England Power Company and Stone & Webster.

JOHN R. GEARY, after 41 years of service with General Electric interests, including the past 27 years as representative of the company in Japan, has retired from active duty. He expects to remain in Japan for some time and will continue to serve as a director of the Tokyo Electric Company, Ltd., and the Shibaura Engineering Works, Ltd.

ARTHUR M. HUDDELL, general president of the International Union of Operating Engineers, was honored recently at a banquet given by the local branches of the union in New York City. More than 2,500 attended what was one of the largest affairs ever held at the Commodore Hotel. The speakers included Thomas C. T. Crain, District Attorney of New York County; Col. William Starrett, president of Starrett Brothers & Eken, Inc.; John F. Carew, Justice of the Supreme Court of New York, and Arthur J. W. Hilly, Corporation Counsel of the City of New York.

JAMES SHEAHAN, for the past eight years superintendent of the Memphis Water Department, is to be honored by the Board of Water Commissioners of the City of Memphis, Tenn., with the naming of the $2,000,000 city water plant as the James Sheahan Pumping Station. When completed, this station will be the largest artesian plant of its kind in the world.

LORNE A. CAMPBELL, general manager of the West Kootenay Light & Power Company, has just been elected a director of the Consolidated Mining & Smelting Company of Canada.

Business Notes

THE LUMMUS COMPANY, a new engineering and contracting firm with authorized capital stock of $10,000,000, has been organized to take over the business of the Walter E. Lummus Company of Boston, Mass. The Superheater Company and the Babcock & Wilcox Company, both of New York City, hold substantial blocks of stock in the new firm. Operating on a larger scale but pursuing the same lines of activities as the old company, the new Lummus' organization will engage in the design and manufacture of distillation and refining equipment for the alcohol, chemical and petroleum industries.

GLOBE STEEL TUBES COMPANY, Milwaukee, Wis., announces the organization of a subsidiary company, known as the GLOBE STAINLESS STEEL COMPANY, to carry on a business of engineering, designing and manufacturing of stainless steel tubes and tubular installations for corrosion and heat resisting purposes. The principal officers of the new company will be the same as those of the parent company, and sales will be handled through the same offices.

WELLS MANUFACTURING COMPANY, San Francisco, Calif., announces that it has taken over the firm of Fichtner & Simon with headquarters in that city. E. C. Fichtner is now associated with the Wells company, and the manufacture of F & S special industrial heaters, water heaters and thermostats will be carried on under the Wells name.

EDWARD VALVE & MANUFACTURING COMPANY, East Chicago, Ind., announces that the Dunbar Engineering Company, 122 East 42nd St., New York City, is now representing the company in those portions of New Jersey, Pennsylvania, Delaware, Maryland and Virginia which have heretofore been handled by representatives located in Philadelphia and Baltimore.

Trade Catalogs

STOKERS, PULVERIZERS AND BOILERS —A new and revised edition of its general condensed catalog, No. GC-6, has just been issued by the Combustion Engineering Corporation, 200 Madison Ave., New York City. This 16-page catalog illustrates and briefly describes the fuel-burning and steam-generating equipment manufactured by the company.

ASH HANDLING — The Allen-Sherman-Hoff Company, 227 South 15th St., Philadelphia, Pa., have just issued two attractively illustrated catalogs on ash handling. Catalog No. 1130 describes with the aid of many interesting photographs of actual installations the advantages of the Hydrojet system of handling ashes, while Catalog No. 1230 shows in detail its applications.

TRANSFORMERS—An illustrated leaflet describing Westinghouse Pothead Type transformers has recently been published by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Listed are the advantages of these transformers for the three general types of potheads — compound-filled single-compartment, oil-filled single-compartment and double-compartment.

PORTABLE ELECTRIC PLANTS — Bulletin No. 100-B of the Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill., illustrates and describes many models of gasoline-engine operated electric-generating plants in capacities from 350 watts to 15 kw. The plants are entirely self-contained, no storage batteries being necessary for their operation. The engines may be adapted for operation on natural gas if desired.

COMBUSTION METERS — The Hays Corporation, Michigan City, Ind., has just issued a new 24-page catalog, No. RA - 31, covering Hays combustion meters for CO_2, draft and flue-gas temperature and boiler panels. The catalog is generously illustrated with half tones and line drawings to show clearly mounting dimensions, method of installation, operating principle and general appearance of the equipment.

COMING CONVENTIONS

American Society of Mechanical Engineers. National Fuels Meeting in Chicago, Ill., Feb. 10-13. Semi-annual meeting in Birmingham, Ala., Apr. 20-23. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Engineering Council. Annual meeting at the Mayflower Hotel, Washington, D. C., Jan. 15-17. Secretary, L. W. Wallace, 26 Jackson Pl., N.W., Washington, D. C.

American Institute of Electrical Engineers. Annual Winter convention in New York City, Jan. 26-30. District meeting in Pittsburgh, Pa., March 9-13. District meeting in Rochester, N. Y., May 6-10. Annual summer convention in Asheville, N. C., June 22-26. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at the William Penn Hotel, Pittsburgh, Pa., Jan. 26-29. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Annual meeting in New York City, Apr. 22-24. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

Engineering Institute of Canada. Annual meeting at the Windsor Hotel, Montreal, Que., Feb. 4-6. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 8-12. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

National Marine Engineers' Beneficial Association. Annual convention at the Lee House Hotel, Washington, D. C., Feb. 9-15. Secretary-treasurer, Albert L. Jones, 313 Machinists Building, Washington, D. C.

Fuel Prices

FUEL OIL

New York—Dec. 31, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.25c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, contract, 6c. per gal.

St. Louis—Dec. 22, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.47 per bbl.; 28@30 deg., $1.595 per bbl.; 30@32 deg., $1.695 per bbl.; 32@36 deg., gas oil, 3.901c.@4.026c. per gal.; 38@40 deg., distillate, 4.526c.@4.776c. per gal.

Pittsburgh—Dec. 24, f.o.b. local refinery, 34@36 deg., fuel oil, 3.37½c.@3.5c. per gal.; 36@40 deg., 3.37½c.@3.5c.

Philadelphia—Dec. 22, industrial use, No. 4, light, $1.31 per bbl.; No. 5, medium, $1.22; No. 6, heavy, (Bunker C) $1.10.

Cincinnati — Dec. 23, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Dec. 22, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 70c. per bbl.; 26@30 deg., 95c. per bbl.; 30@32 deg., $1.00 per bbl.

Boston—Dec. 29, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.9c. per gal.; 28@32 deg., 4.8c. per gal.

Dallas—Dec. 27, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol..	New York...	$1.90 @$2.25
Pool 10, hr.gr. low-vol.	New York...	1.75 @ 1.85
Pool 11, low-vol.....	New York...	1.60 @ 1.75
Smokeless, mine-run..	Chicago.....	1.75 @ 2.25
Smokeless, slack.....	Chicago.....	.60 @ 1.35
Harlan, Ky., slack. ...	Chicago.....	.50 @ .90
Franklin, Ill., mine-run	Chicago.....	2.15
Franklin, Ill., screen...	Chicago.....	1.35 @ 1.60
Ind. 5th Vein, m.-r....	Chicago.....	1.50 @ 1.85
Standard Ill., mine-run	St. Louis.....	1.50
W. Ky., mine-run	Louisville....	1.00 @ 1.35
W. Ky., slack.....	Louisville....	.40 @ .60
Pittsburgh, mine-run.	Pittsburgh....	1.30 @ 1.60
Smokeless, mine-run..	Cincinnati...	1.75 @ 2.25
Smokeless, slack.....	Cincinnati...	.75 @ 1.35
Kanawha, mine-run..	Cincinnati...	1.10 @ 1.35
Kanawha, nut-slack .	Cincinnati...	.50 @ .75

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat.....	New York...	$3.50
Barley.....	New York...	1.50

A Starter for 1931

Again come the traditional New Year resolutions, but this time in a setting that gives them added meaning and force. With feet on the solid rock of business realities, while signs of an early dawn tint the horizon, thousands of individuals greet 1931 with level-headed determination. Their united resolutions may well give this old world the push it needs to start things on the upgrade.

Inventories are so small that the burden we felt five years ago, of having to complete counts by the first week in January, has not been with us during the holidays.

Budgets, too, have been so modified by the very indefiniteness of conditions, that our figures this year are to be written on fresh sheets. With everything in favor of those who pull the strongest oar, 1931 can be made a memorable year in this decade; and the turning point of the inheritance from the last of the twenties.

We have much for which to be thankful despite some things over which we may grieve, yet that which gives us comfort gives us inspiration, and inspiration, with its associate forces, enthusiasm, energy and aggression, should be our guiding star in this new year.

As engineers we can start putting in the new things that do not involve extraordinary expense; making each a preparation for the larger jobs we have planned. Such contributions will start the new year moving in the right direction, a heap sight better than grumping around the plant doing little else than keeping things going.

The old truth—about helping ourselves—was never more applicable than now, in the beginning of this, the New Year.

May the best come to each of you,
and so
to all.

George Edwards.
Engineer

COCHRANE
HOT PROCESS SOFTENER

Best for High Pressure Boilers

EXPERIENCE with the Cochrane Lime Soda Hot Process Softener with supplementary phosphate feed according to the Hall System has demonstrated that high pressure boilers can be kept free of scale, with the tendency to foaming and priming greatly reduced, even where the boiler feed consists entirely of softened make-up and a 3 to 1 ratio of sodium sulphate to sodium carbonate is maintained as recommended by the A.S.M.E. Boiler Code Committee. The following installations are representative:

CONCERN	BOILER PRESSURE	PER CENT MAKE-UP	CAPACITY Gal. per Hr.
Kansas City Pwr. & Lt. Co.	650	80	56,000
Philip Carey Mfg. Co.	375	60	6,000
Mathieson Alkali Co.	...	80	18,000
Pittsburgh Steel Co.	400	100	70,000
Anheuser Busch Corp.	450	75	28,000
Mead Straw Pulp & Paper Co.	400	50	14,000
John H. Heald Co.	300	40	12,000
Philadelphia Coke Co.	250	100	12,000
Champion Coated Paper Co.	650	25	24,000
Magnolia Petroleum Co.	400	100	70,000
Diamond Alkali Co.	750	100	60,000

If you operate steam boilers you will find much of interest and value in our Publication L-1746, "Hot Lime-Soda-Phosphate Treatment of Feed Water"; sent upon request.

COCHRANE CORPORATION

17th and Clearfield Streets, Philadelphia, Pa.

F-13

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., St. Helena—Pacific Gas & Electric Co., 245 Market St., San Francisco, will build substation additions at St. Helena and Yountville. Work will be done by day labor.

Calif., San Francisco—Constructing Quartermaster, Fort Mason, is having plans prepared for remodeling hot water heating plant at Commanding Generals Quarters, also installing 300 hp. boiler at Central heating plant at Fort McDowell.

Calif., San Francisco—Constructing Quartermaster, Fort Mason, will soon award contract for alterations to electric feeder system at Letterman General Hospital.

Calif., San Bernardino — San Bernardino County Waterworks Dist. 9, is having plans prepared for extensions and improvements to waterworks, including pumping plants, filter system, etc. Estimated cost $50,000.

Ill., Champaign—Holabird & Root, 333 North Michigan Ave., Chicago, Archts., are receiving bids for a 1 story, 196 x 209 ft. skating rink, including refrigeration system on 5th St. here for University of Illinois. Estimated cost $200,000.

Ind., Bedford—City awarded contract for addition to pumping station to Heitger & Garriott. Estimated cost $15,000.

La., Donaldsonville — City, S. A. Marchand, Mayor, will receive bids until Jan. 26 for the construction of a sanitary sewage system, including pumping station, etc.

La., New Orleans—Sewerage & Water Board, awarded contract for alterations to pumping station C. to C. N. Bott, Audubon Bldg.; four transformers for main purification plant to Maloney Electric Co., Union Indemnity Bldg., St. Louis, Mo.

Mass., Brookline—Edison Electric Illuminating Co., 39 Boylston St., Boston, is having plans prepared for the construction of a power substation at Beaconsfield and Dean Rds. here. Estimated cost $50,000. I. E. Moultrop, 39 Boylston St., Boston, is engineer.

Mass., Natick — Framingham & Natick Ice Mfg. Co., c/o J. A. Hill, 90 Pond St., will build a 1 story, 60 x 110 and 75 x 95 ft. artificial ice plant, storage building and office on West Central St. Estimated cost $75,000. C. Coneby Engineering & Construction Co., Cleveland, O., are engineers. Work will be done by separate contracts.

Mass., Turners Falls—Turners Falls Power & Electric Co., G. W. Lawrence, Pres., will build a power generating plant, outside transformer and transmission equipment. Estimated cost $500,000. Private plans. Work will be done by owner's forces.

Mass., West Medway — Edison Electric Illuminating Co., 39 Boylston St., Boston, plans additions and improvements to power substation here. Estimated cost $167,000. Private plans.

Mass., Yarmouth — Town is having plans prepared for waterworks improvements, including pumping station, mains, etc. Estimated cost $75,000. Engineer not selected.

Mich., Baraga—Baraga County Light & Power Co., is having plans prepared for the construction of a hydro-electric plant on Sturgeon River near here. Plans include dam, 55 ft. high, power house, two 1,600 hp. direct connected units. Holland, Ackerman & Holland, 20 North Wacker Dr., Chicago, Ill., Engrs., are receiving bids for equipment and will receive bids late in January for dam and power house.

Mich., St. Joseph—City is having plans prepared for the construction of a 4,000,000 gal. filtration plant and pumping station. Estimated cost $175,000. Gordon & Bulot, 53 West Jackson Blvd., Chicago, Ill., are engineers.

Mo., St. Louis—Union Electric Light & Power Co., 12th and Locust Sts., awarded contract for the construction of a 53 x 70 ft. power substation at 15th and Linden Sts. to Fruin-Colnon Contracting Co., Merchants-Laclede Bldg.

Mo., St. Louis—Treasury Dept. Office of J. A. Wetmore, Supervising Archt., Washington, D. C., is having plans prepared for the construction of a federal building at 12th Blvd. and Market St. here. Mauran, Russell & Crowell, Chemical Bldg., St. Louis, are architects.

Neb., Hastings — Hastings College, C. H. French, plans the construction of a group of buildings, including main building, heating plant, etc. Estimated total cost $760,000. Architect not selected.

Neb., Orleans—Western Public Service Co., Scottsbluff, will build a 35 x 70 ft. power plant including 1,050 hp. Fairbanks Morse oil engine direct connected to 720 kw. electro generator here. Work will be done by local labor under the supervision of S. J. Connolly, Engr.

Nev., Las Vegas—Dept. of Interior, Bureau of Reclamation, Wilda Bldg., 1441 Welton St., Denver, Colo., will receive bids until Mar. 4 for the construction of Hoover dam (Boulder dam project), including power plant, etc., in the upper Black Canyon on the Colorado River, 30 mi. southeast of Las Vegas on the Arizona-Nevada-California state lines. Estimated cost approximately $108,800,000.

N. J., Carlstadt—Carlstadt Consumers Ice Co., 501 11th St., is having preliminary plans prepared for remodeling ice plant. Estimated cost $40,000. Architect not announced. Machinery and equipment will be required.

N. J., Garfield—Garfield Crystal Ice Co., Midland Ave., awarded contract for the construction of a 100 x 100 ft. ice plant to Mahony-Trodst Construction Co., 657 Main Ave., Passaic. Estimated cost $75,000.

N. J., Paterson—Bd. of Chosen Freeholders, Court House, will receive bids about Mar. 1 for the construction of a 20 story county detention jail and hall of records building including steam heating, ventilation and refrigeration systems, boilers, elevators, etc., at Grand St. between Spring and Jackson Sts. Estimated cost $3,500,000. H. B. Crosby, First National Bank Bldg., is architect.

N. Y., Brooklyn—Supreme Coal & Ice Co., 551 Nostrand Ave., is receiving bids for the construction of an ice manufacturing plant at Lexington and Marcy Aves. Estimated cost $75,000. Bly & Hamann, 551 Nostrand Ave., are architects.

N. Y., Coney Island (sta. Brooklyn)—Dept. of Hospitals, Municipal Bldg., New York, plans the construction of an emergency department and refrigeration plant at Coney Island Hospital. Estimated cost to exceed $40,000. G. M. McCabe, 96 5th Ave., New York, is architect.

N. Y., Dongan Hills — Dept. of Hospitals, Municipal Bldg., New York, plans the construction of a power house and heating system at Sea View Hospital, here. Estimated cost $40,000. Sibley & Fetherston, 205 East 42nd St., New York, are architects.

N. Y., New York—Dept. of Hospitals, Municipal Bldg., plans the construction of a refrigeration plant at Randall Island. Estimated cost $40,000. Van Wart & Wein, 347 Madison Ave., are architects.

N. D., Grand Forks—Bd. of City Commissioners, will receive bids until Jan. 14 for waterworks improvements, including pump house, mains, etc. Estimated cost $52,000. Burns & McDonnell, 402 Interstate Bldg., Kansas City, Mo., are consulting engineers. E. L. Dium is city engineer.

O., Cincinnati—Cincinnati Union Terminal Co., awarded contract for switching equipment and interlocking plant at Cincinnati terminal to Union Switch & Signal Co., Swissville, Pa. Estimated cost $1,500,000.

O., Selby—City is having plans prepared for extensions and improvements to power plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., are engineers.

Okla., Tulsa—City Commissioners, E. Logan, Auditor, Municipal Bldg., is having plans prepared for a central building and electrical equipment for underground fire alarm system. Estimated cost $275,000.

Pa., Pittsburgh — U. S. Engineer, Keenan Bldg., received low bids for furnishing and installing a hydro-electric plant in power house of lock and dam No. 8, on the Allegheny River.

Alta., Calgary—Calgary Power Co., plans the construction of a power development on Athahasca River northwest of Edron. Initial cost $5,000,000.

Man., Winnipeg — Winnipeg Hydro-Electric Commission, will receive bids early in January for addition to hydro-electric plant. Estimated cost $450,000.

Ont., Toronto—Dept. of Public Works, Parliament Bldgs., will build a 6 story addition to East Block Parliament Buildings including steam heating system, etc. Estimated cost $1,000,000. Work will be done by day labor under the supervision of Jackson-Lewis Construction Co., 95 King St. E.

Equipment Wanted

Boilers—Waltham, Mass.—Dept. of Mental Diseases, will receive bids until Jan. 13 for additional boilers for Metropolitan State Hospital.

Boiler Equipment—New Orleans, La.—Charity Hospital, plans furnishing and installing boiler equipment. Estimated cost $12,500.

Electrical Equipment—Washington, D. C.—A. L. Flint, General Purchasing Officer of the Panama Canal, will receive bids until Jan. 19 for electrical equipment for towing locomotives.

Engine—Cambridge C, Mass.—P. O. Box 22, plans to purchase a Diesel oil engine direct connected from 40 to 65 kw., 125 v. d.c. generator.

Pumps—Lindsay, Ont.—City will soon receive bids for pumps, etc., for proposed sewage disposal plant. Estimated cost $106,000.

Pumps, etc. — Gilford, Ont. — Township of West Gwillimbury, F. Ritchie, Clk., pumps, etc., in connection with proposed irrigation work. Estimated cost $175,000.

Pumps, etc.—Lakefield, Ont.—Village plans the installation of pumps, etc., in connection with waterworks improvements. Estimated cost $50,000.

Industrial Projects

Calif., Oakland — C. N. Burrell, American Bank Bldg., Archt., is receiving bids for a 1 story factory on 102nd Ave. for Hammer-Bray Co., 26th Ave. and East 12th St. Estimated cost $200,000.

Conn., Bridgeport—Linstrom Tool & Toy Co., Silliman St., awarded contract for a 2 story, 50 x 150 ft. factory, to T. J. Pardy Construction Co., 1481 Seaview Ave. Estimated cost $50,000.

Mass., Beverly—Gulf Refining Co., Park Sq., Bldg., Boston, is having plans prepared for the construction of and equipment for boiler house at Water St. here. Estimated cost $40,000. Private plans.

Mass., Wellfleet—Powdrell & Alexander, Inc., 175 Connecticut Mills Ave., Danielson, Conn., plans the construction of a 2 story factory, here. Estimated cost to exceed $40,000. W. B. Brennan, c/o owner, is engineer.

N. J., Lakewood — D. J. Serocco, 60 Park Pl., Newark, Archt., will probably receive bids about Mar. 1 for the construction of a motion picture and radio broadcasting studio at Pine Forest Manor here, for Lakewood Studio Co., G. H. Glass, Pres., c/o architect. Estimated cost $500,000.

Okla., Ponca City—Great Lakes Pipe Line Co., awarded contract for the construction of a pumping station to J. W. Whitehurst, $150,000.

Tex., Liberty—Texas & Louisiana Tool Co., acquired a site and plans the construction of a tool making plant.

Utah, Woodside—Carbon Dioxide & Chemical Co., F. Goodwin, Exec. V. Pres., has work under way on the construction of a dry ice plant. Initial cost $50,000. Ultimate total cost $1,000,000. Work being done by day labor.

Ont., London—Hyatt Jumbo Roofing Co., 10 Aylmer St., Windsor, is having plans prepared for the construction of a factory on Richmond St. here. Estimated cost $100,000. Private plans.

Ont., Oshawa—Oshawa Industrial Foundation Ltd., Owners and Contractors, c/o Chamber of Commerce, plans the construction of a 1 story, 100 x 150 ft. factory. Estimated cost $60,000. C. C. Stenhouse is architect. Coulter Mfg. Co., c/o Coulter Copper & Brass Co. Ltd., 115 Sumach St., Toronto, lessee.

Ont., Port Colborne—Canada Cement Co. Ltd., H. O. Canada Cement Bldg., Montreal, Que., plans the construction of a cement plant, 500 ton daily capacity here, to include electric power, cement making kilns and equipment, conveyors, storage bins, etc. Estimated cost $500,000. S. H. Barr, H. O. Canada Cement Bldg., Montreal, Que., is chief engineer.

Ont., Toronto — Crompton, Parkinson Ltd., Dagenham, England, manufacturers of electrical apparatus, plans the construction of a plant here.

Que., Montreal—Dominion Rubber Co., Ltd., Notre Dame St. E., plans addition to plant. Estimated cost $100,000.